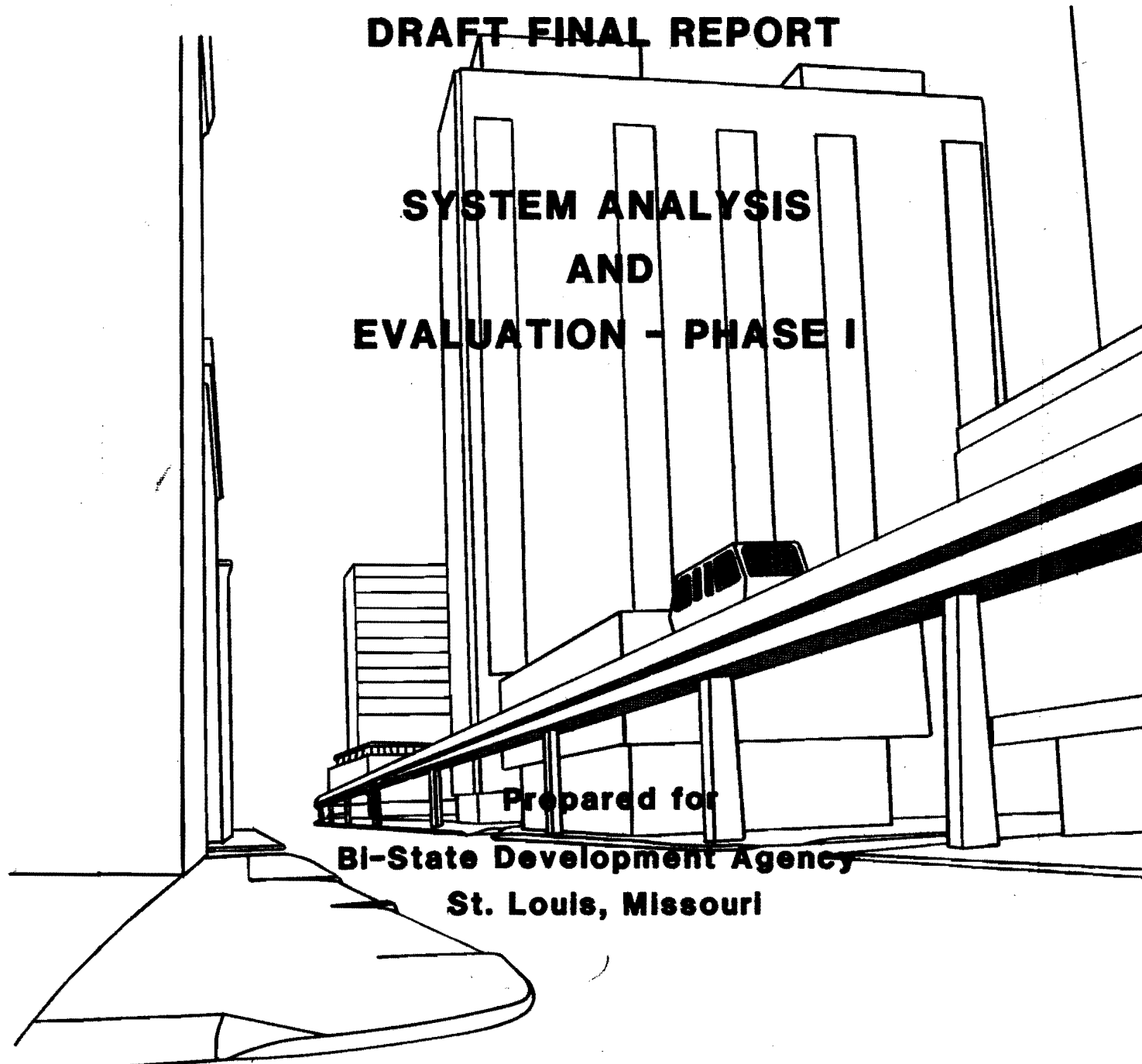


DOWNTOWN PEOPLE MOVER FEASIBILITY STUDY

ST. LOUIS, MISSOURI

DRAFT FINAL REPORT

**SYSTEM ANALYSIS
AND
EVALUATION - PHASE I**



**Prepared for
BI-State Development Agency
St. Louis, Missouri**

Prepared by

Booker/Bernard Johnson

Bi-State Development Agency
Downtown People Mover (DPM)
Technical Review Committee

December 9, 1980

A G E N D A

✓ Opening Remarks	Edward Madison
✓ Introduction	Roger Peterson
Study Background	John M. Zimmer
Goals and Objectives	John M. Zimmer
Alternative Alignments Engineering Stations	Joseph Marking
✓ Joint Development	James Prost
✓ Alignment Evaluation	James Prost
✓ Patronage and Revenue	Joseph Marking
✓ Recommended Alignment	Joseph Marking
DPM Systems	John M. Zimmer

proceeding
LA
Jacksonville
Detroit
Indianapolis
Miami
A. Paul

10 ft up; 100 ft column centers
Morgantown, Hamilton Ont

500,000 sq ft office, \$400 million total investment of DPM
\$2.2 million annual passenger revenue from \$1.25 fare;
would eliminate 22 local lines from core; \$670,000 annual savings
Don't cost savings = (nearly) annual operating costs
\$88 million total cost 4A; free transfer; assumes LRT but not in revenue
LA has 1.8 million annually toward operating cost,
\$170-200 million; 20% local (gasoline tax) 80% UMTA
MIAMI has full funding requirement

cost
beginning '81
40-50%
needed to build

proposition

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EVALUATION - PHASE I

Prepared For
BI-STATE DEVELOPMENT AGENCY

by
Booker/Bernard Johnson, A Joint-Venture

In Association With:
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TABLE OF CONTENTS

	<u>Page</u>
This Table of Contents.....	i
List of Figures.....	iv
List of Tables.....	vi
 <u>Chapter</u>	
I. INTRODUCTION.....	1
Description of St. Louis.....	2
Central Business District.....	2
Study Area.....	6
Study Methodology.....	8
Technical Review Committee.....	10
Community Interaction Program.....	11
Public Meetings.....	12
Development of a Community Advisory Board.....	12
Media Releases.....	13
II. GOALS AND OBJECTIVES.....	14
Formulation of Goals and Objectives.....	14
Responses.....	15
III. SCREENING DPM ALTERNATIVE ALIGNMENTS.....	19
Overview of Process, Assumptions, and Criteria.....	19
Initial Route Options Considered.....	19
Route Option A.....	20
Route Option B.....	20
Route Option C.....	20
Route Option D.....	21
Route Option E.....	21
Route Option F.....	21
Route Option G.....	21
Route Option H.....	22
Route Option I.....	22
Route Option J.....	22
Route Option R-1.....	44
Route Option R-2.....	44
Route Option R-3.....	47
Route Option R-4.....	47
Route Option R-5.....	50
Route Option R-6.....	50
Description of Alternative Alignments.....	50
Alternative Alignment 1.....	53
Alternative Alignment 1A.....	56
Alternative Alignment 2.....	59
Alternative Alignment 3.....	61
Alternative Alignment 4.....	63
Alternative Alignment 4A.....	66

Table of Contents, Cont.

	<u>Page</u>
IV. ANALYSIS OF CANDIDATE ALIGNMENTS.....	68
Engineering, Guideway, and Systems.....	68
Vehicle Suppliers and Characteristics.....	68
Guideway Types.....	74
Guideway Characteristics.....	78
Basic Stations.....	83
Support Facilities.....	86
Construction, Operations, and Maintenance Costs.....	88
Economic and Development Impacts.....	92
Methodology.....	92
Impacts on Existing Development.....	94
Linkages of CBD Activities.....	96
Joint Development Potential.....	98
Relationship to Activity Centers.....	104
Parking and Commuter Intercept.....	105
Patronage Estimates.....	105
Patronage Estimation Methodology.....	108
Forecasting Assumptions.....	111
Diversion Estimates for DPM Alternatives.....	112
Planning Considerations.....	116
Potential Passenger Revenue.....	117
Environmental, Visual, and Historic Impacts.....	118
Emissions.....	118
Energy Consumption.....	121
Noise.....	123
Aesthetic Quality.....	123
Historic.....	124
Impacts on Bus System.....	124
Expansion Potential.....	129
V. EVALUATION AND SELECTION OF RECOMMENDED ALIGNMENT.....	134
Trade-offs Among Alternative Alignment.....	134
Relationship to Goals and Objectives.....	134
Bus Only Alternative.....	146
VI. REFINEMENT OF ALTERNATIVE ALIGNMENT FOUR.....	149
Engineering, Guideways, and Systems.....	149
Guideway Location.....	150
Engineering Issues.....	154
Construction Costs.....	159
Economic and Development Impacts.....	163
Station Area Descriptions.....	165
Office Development Potentials.....	173
Patronage.....	179
Environmental, Visual, and Historic Impacts.....	180
Emissions.....	180
Energy Consumption.....	181
Noise.....	181
Aesthetic Quality.....	182
Historic.....	185

Table of Contents, Cont.	<u>Page</u>
Impacts on Bus System.....	185
Expansion Potential.....	186
VII. CONCLUSIONS AND RECOMMENDATIONS.....	187

APPENDICES

LIST OF FIGURES

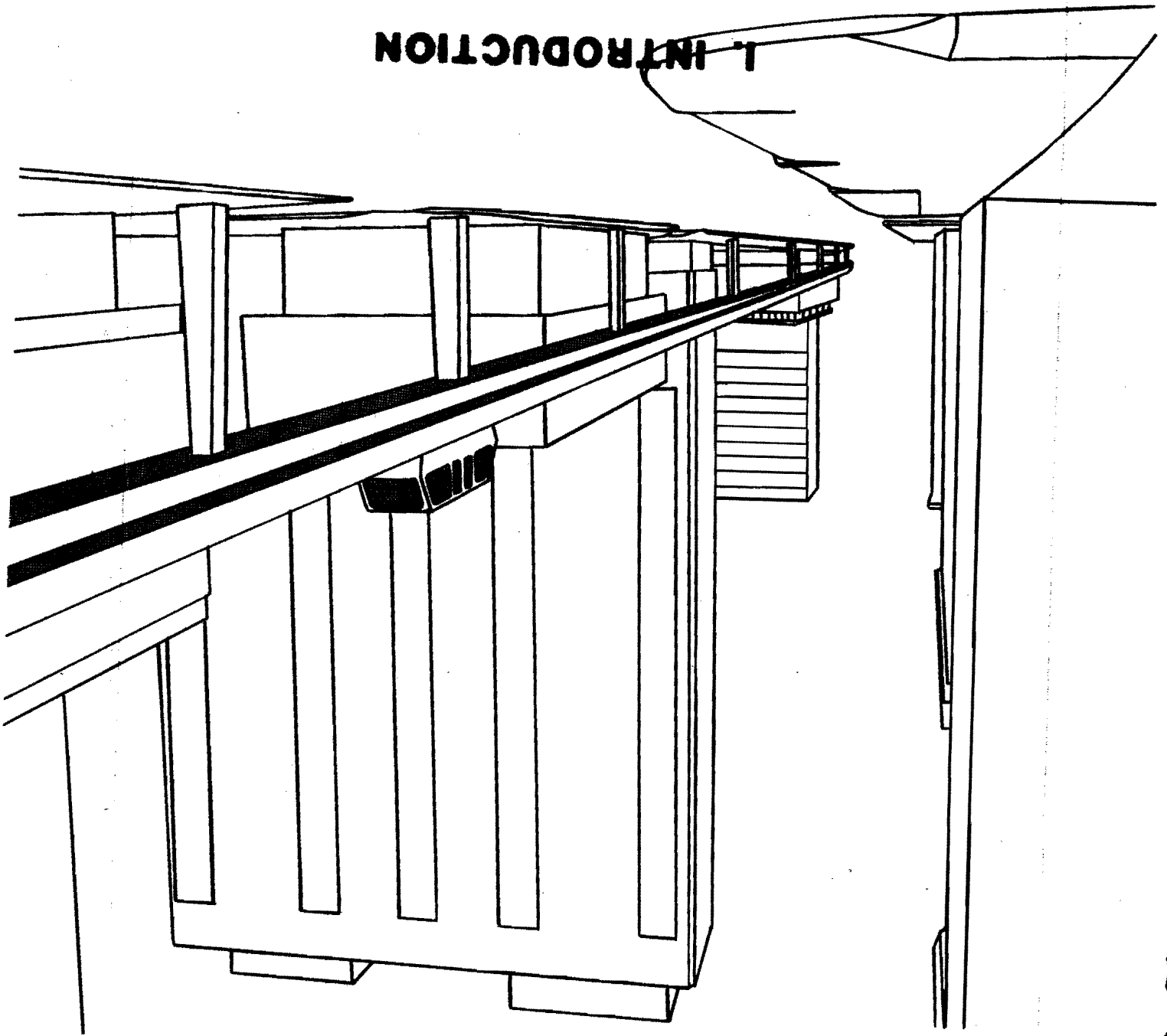
Figure	Page
1. Major Activities.....	4
2. Study Area.....	7
3. 1985 Employment Projections.....	9
4. St. Louis DPM Goals & Objectives - Ranking.....	17
5. Route Option A.....	23
6. Route Option B.....	25
7. Route Option C.....	27
8. Route Option D.....	30
9. Route Option E.....	32
10. Route Option F.....	34
11. Route Option G.....	36
12. Route Option H.....	38
13. Route Option I.....	40
14. Route Option J.....	42
15. Route Option R-1.....	45
16. Route Option R-2.....	46
17. Route Option R-3.....	48
18. Route Option R-4.....	49
19. Route Option R-5.....	51
20. Route Option R-6.....	52
21. Alternative Alignment 1.....	54
22. Alternative Alignment 1A.....	58
23. Alternative Alignment 2.....	60
24. Alternative Alignment 3.....	62
25. Alternative Alignment 4.....	64
26. Potential Vehicle Suppliers.....	69
27. Guideway Types.....	75
28. Guideway Characteristics.....	79
29. Basic Station Configuration.....	84
30. Administration, Maintenance, & Storage Area.....	87
31. Guideway Costs (1980).....	89
32. Ratings of Joint Development Potential by Alignment, Long Term versus Short Term.....	102
32A. Parking Facilities.....	106
33. Architectural Historic Survey and Overhead Structures.....	125
34. Alternative Alignment 1, Expansion Potential.....	130
35. Alternative Alignment 2, Expansion Potential.....	131
36. Alternative Alignment 3, Expansion Potential.....	132
37. Alternative Alignment 4, Expansion Potential.....	133
38. Ratings of Joint Development Potential by Alignment, Economic Development/Land Use Goals.....	139
39. Ratings of Joint Development Potential by Alignment, Transportation Goals.....	140
40. Ratings of Joint Development Potential by Alignment, Cost/Effectiveness Goals.....	141

List of Figures, Cont.	<u>Page</u>
41. Ratings of Joint Development Potential by Alignment, Environmental Goals.....	142
42. Ratings of Joint Development Potential by Alignment, Social Goals.....	143
43. Ratings of Joint Development Potential by Alignment, Composite Weighted Values.....	144
44. Bus Only Option.....	147
45. East Loop Profile (Base Route).....	151
46. West Loop Profile (Base Route).....	152
47. Plan-Typical Street Intersection.....	155
48. Plan "Y" Intersection.....	156
49. Typical Section at 8th Street.....	158
50. Typical Station Design, Longitudinal Elevation.....	183
51. Typical Station Design, Plan at Ground Level.....	184

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. St. Louis DPM Goals and Objectives Ranked by Order of Importance.....	18
2. Route Option A, Potential Advantages and Disadvantages.....	24
3. Route Option B, Potential Advantages and Disadvantages.....	26
4. Route Option C, Potential Advantages and Disadvantages.....	28
5. Route Option D, Potential Advantages and Disadvantages.....	31
6. Route Option E, Potential Advantages and Disadvantages.....	33
7. Route Option F, Potential Advantages and Disadvantages.....	35
8. Route Option G, Potential Advantages and Disadvantages.....	37
9. Route Option H, Potential Advantages and Disadvantages.....	39
10. Route Option I, Potential Advantages and Disadvantages.....	41
11. Route Option J, Potential Advantages and Disadvantages.....	43
12. Comparison of Impacts on Existing (1985) Development.....	95
13. Summary of Joint Development Potential for Each Candidate Alignment.....	101
14. Summary, St. Louis DPM Patronage Analysis Average Weekday Ridership.....	107
15. 1985 Average Weekday DPM Trips : Alignment 1.....	113
16. 1985 Average Weekday DPM Trips : Alignment 2.....	114
17. 1985 Average Weekday DPM Trips : Alignment 3.....	115
18. 1985 Average Weekday DPM Trips : Alignment 4.....	116
19. St. Louis DPM Average Weekday Ridership with 10¢ Fare.....	117
20. 1985 Annual DPM Passenger Revenue.....	119
21. Auto Trips Converted into DPM Patronage.....	120
22. Bus Miles Saved by DPM Intercept.....	120
23. VMT/Tons of Pollutant Burden Saved Per Year.....	121
24. System Energy Requirements.....	122
25. Local Downtown Bus Routes Reviewed for DPM System Induced Route Changes.....	127
26. Annual Cost Savings for Weekday Operation of Local Bus Routes in Downtown St. Louis.....	129
27. Summary Comparison of Alternatives.....	135
28. Alignment 4 - Estimated Costs.....	160
29. Alternative 4 and Options - Estimated Costs.....	161
30. Typical Station Costs.....	164
31. Station Patronage Activities - Alternative 4.....	180

I. INTRODUCTION



I. INTRODUCTION

Over the past ten years, much interest in new mass transit technology has been shown throughout the country at all levels of government. Reasons for this include increased access for the public, potential redevelopment of older cities, better structuring of urban land use, and efficient use of energy sources. One of the types of technology that has shown the most promise and in which interest has been shown at the local level is Automated Guideway Technology (AGT) specifically as it applies to the Downtown People Mover (DPM).

Initially, AGT systems were built at several major airports and operated as shuttles from parking areas to terminals and/or between several terminals. Two early examples are the AGT systems at Tampa International Airport and Dallas-Fort Worth International Airport. These systems are comprised of small vehicles, 10 to 20 passengers, that are automatically operated (no on-board driver or operator).

In 1969, the Federal Urban Mass Transportation Administration (UMTA) funded a demonstration project for an AGT system in Morgantown, West Virginia. This system consists of 2.2 miles of double guideway with stations connecting the campuses of West Virginia University. The system opened in 1975 and is presently carrying approximately 65,000 passengers per week. The system is scheduled for a 1.4 mile and two station expansion in the near future.

Early in 1976, UMTA requested "expressions of interest" from cities desiring to participate in DPM projects. Sixty-five cities submitted letters, 38 submitted proposals. In late 1976, UMTA announced that four cities, Cleveland, Houston, Los Angeles, and St. Paul, were selected as potential DPM sites. Another group of cities, including St. Louis, were selected for DPM feasibility studies.

DESCRIPTION OF ST. LOUIS

The St. Louis Metropolitan Area, with approximately 2.5 million people, is one of the fifteen largest areas in the country. The City of St. Louis has a population of approximately 500,000 persons and is the hub of the region containing most of the area's financial, service, and cultural facilities. The City is a major source of employment for the region with about 50 percent of the region's 1,000,000 jobs. At the core of the City is the Central Business District (CBD) which is the location of the proposed DPM System.

CENTRAL BUSINESS DISTRICT

The St. Louis CBD is an area of approximately 1.35 square miles bounded by Chouteau Avenue on the south, North-South Distributor Highway on the west, Carr Street on the north and the Mississippi River on the east. Within this boundary is the financial and employment center of the City along with many of the region's cultural and tourist attractions. Located in the CBD are:

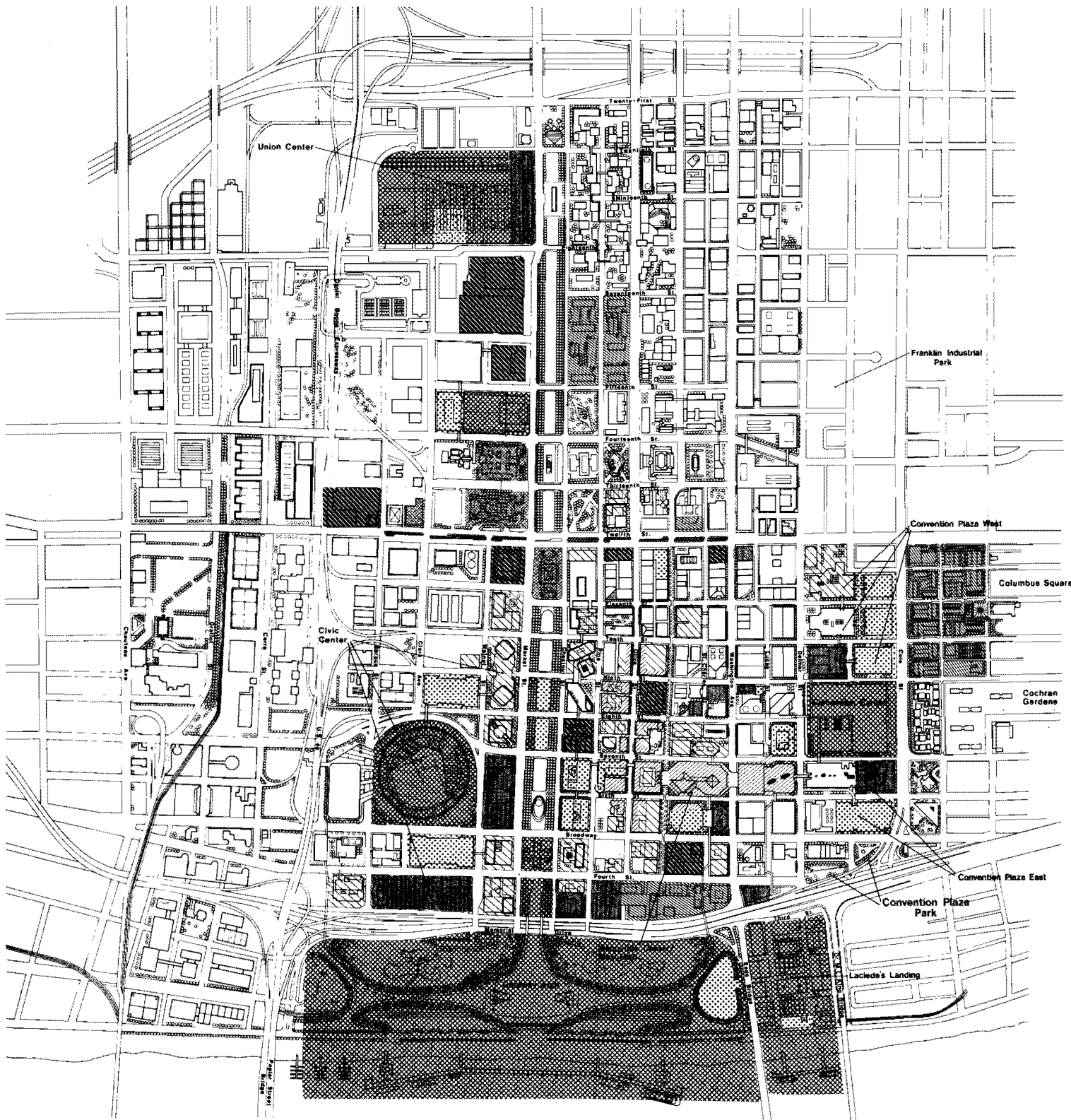
- Jefferson National Expansion Memorial
Site of the Gateway Arch and 2.5 million visitors per year
- A. J. Cervantes Convention and Exposition Center
A 400,000 square foot convention facility
- Busch Memorial Stadium
Home of the Cardinals baseball and football professional sports team
- Headquarters for three of the five largest banks in the State of Missouri
- Headquarters of several international companies including:
Ralston-Purina Company
May Company

Peabody Coal Company
Missouri Pacific Corporation
Interco
Pet, Incorporated
Southwestern Bell Telephone
plus insurance, communication, and professional service firms.

In addition to existing facilities within the CBD, major new developments have been announced or are under construction. According to the St. Louis Community Development Agency (CDA), a total of over \$530 million in new construction has been completed since 1970; an additional \$200 million is under construction and over \$400 million is planned to be completed by 1985.

As shown in Figure 1, downtown activities in St. Louis can be clustered into eight categories. Following is a description of each category.

- Private Office Buildings - This activity is clustered in the area south of Washington Avenue and east of Tucker Boulevard. Some scattered sites are located west of Tucker Boulevard and along Tucker Boulevard north of Washington Avenue.
- Federal and State Office Buildings - These buildings are fairly well scattered throughout the core of the CBD. None, however, are located north of Washington Avenue and those west of Tucker Boulevard are south of Market Street and the Gateway Mall.
- City Government Buildings- All City government activities are clustered within two blocks of the intersection of Tucker Boulevard and



Downtown People Mover Feasibility Study

Booker / Bernard Johnson

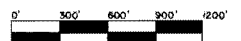
Figure 1

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

Legend

- Major Private Office Buildings
- Major Federal & State Government Office Buildings
- Major City Government Office Buildings
- Hotels
- Special Attraction Area
- Residential
- Retail
- Parking Garage

MAJOR ACTIVITIES



Market Street at the southwest corner of the core area.

- Hotels
 - While somewhat scattered, the hotels are still grouped to some extent near Busch Memorial Stadium, the Gateway Arch, and the Convention Center. Major new hotels are planned in conjunction with the rehabilitation of Union Station and the May Mall in the center of the CBD.
- Special Attraction Areas
 - These activities are located on the periphery of the core and include the Gateway Arch, Convention Center, Laclede's Landing, Busch Memorial Stadium, Union Station, and Kiel Auditorium.
- Residential Developments
 - Includes all non-hotel residential structures. They are concentrated in three areas: Mansion House, near the Gateway Arch; Plaza Square, west of Tucker Boulevard; and Columbus Square-Cochran Gardens, along the north boundary of the core.
- Retail Areas
 - Concentrated along an "L" shaped corridor of Olive Street and Sixth and Seventh Streets. This corridor includes the two major downtown department stores, Famous-Barr and Stix, Baer and Fuller, and the May Mall connecting them. Other isolated retail activity occurs throughout the core.

- Parking
 - The major parking facilities, mainly multi-level garage structures are located along the northern and southern peripheries of the core with some structures within the core itself. City policies have been to encourage peripheral parking facilities.

STUDY AREA

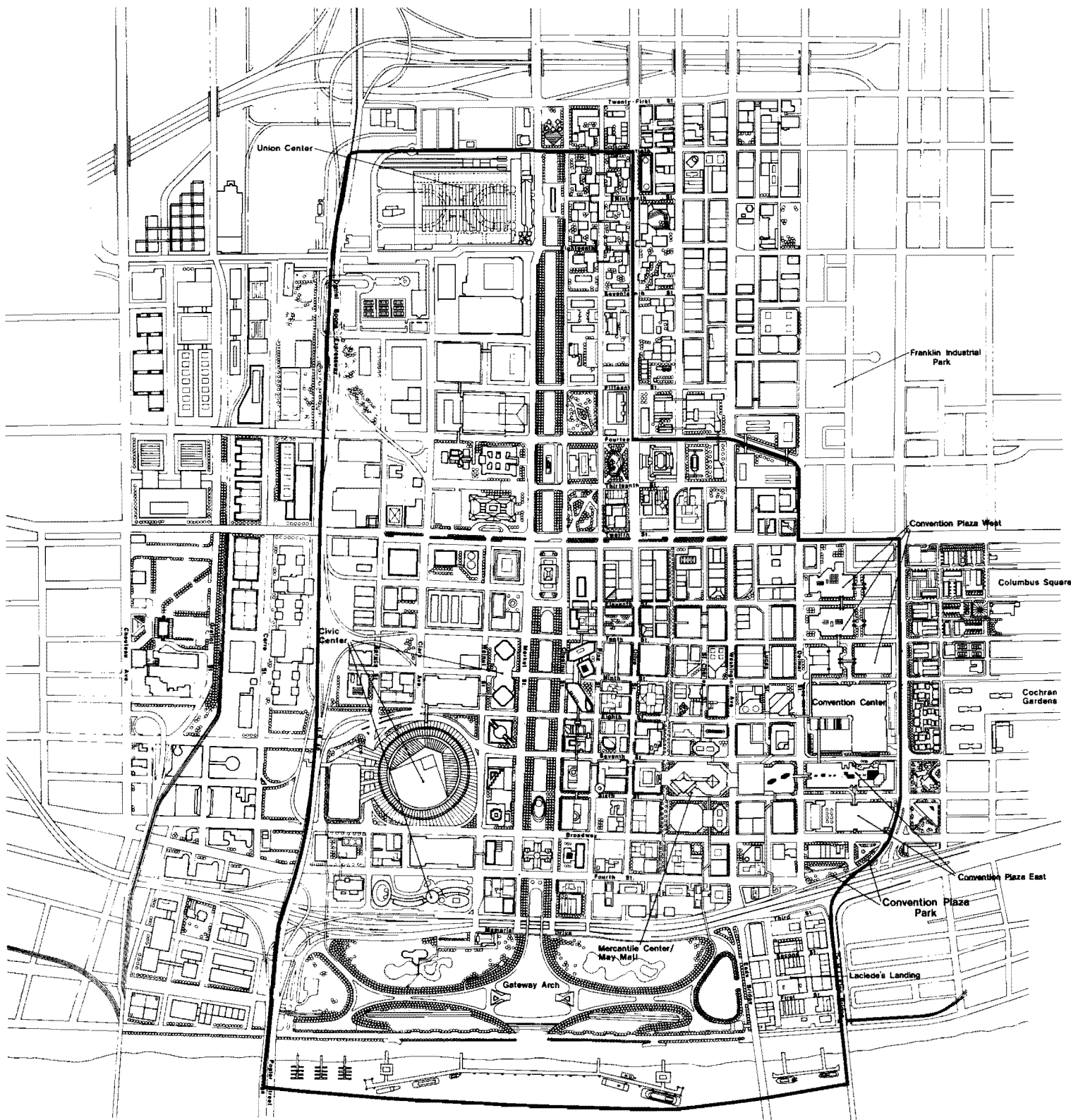
Within the St. Louis CBD, a DPM study area was defined to include the major downtown activities. The study area is shown in Figure 2 and includes most of the CBD with the exception of that area south of U.S. Route 40 and north of Olive Street, west of Fourteenth Street. The study area includes all the major activities of the CBD along with the major employment and tourist areas.

Study Area Employment

One of the more critical characteristics of the DPM study area is the projected employment for the year in which the DPM is anticipated to begin operation. For purposes of this study, an initial operating year of 1985 was used.

In order to determine the study area employment, all available employment data in the St. Louis CBD was obtained. This included the following:

- 1970 and 1995 Downtown Employment by transportation zones; East-West Gateway Coordinating Council
- St. Louis CBD Employment Data Base, 1980; East-West Gateway Coordinating Council (Data from 1977-1979 telephone interviews and Missouri State Employment Division records)



Downtown People Mover Feasibility Study

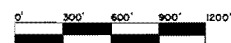
Booker / Bernard Johnson

Legend

STUDY AREA

Figure 2

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri



- Space-Use Study of Downtown St. Louis, 1978; St. Louis Community Development Agency
- St. Louis, 1985; St. Louis Community Development Agency

As is the experience in most older cities like St. Louis, CBD employment has been dropping over the past 30 years, this downtrend has continued to 1980. The Gateway Council study area employment for 1980 is estimated at 81,000 persons. This number is considered fairly accurate; however, the St. Louis CDA suspects it is slightly low due to difficulty in obtaining accurate employment figures for certain service and professional firms. CDA feels the correct 1980 employment for the study area is between 85,000 and 90,000 persons. For purposes of this study, a 1980 employment of 85,000 was used for the study area.

1985 Employment Projection

Utilizing the data noted above and CDA estimates of proposed developments, employment estimates were made for each transportation zone in the study area for 1985. These employment numbers are presented in Figure 3.

As presented in Figure 3, employment is fairly well distributed throughout the study area. An estimated 103,000 persons will be employed in the study area by 1985. This may seem like a rather large increase, 21 percent over five years, but considering the large amount of development and rehabilitation planned and that under construction in the CBD, this number does not seem unreasonable.

STUDY METHODOLOGY

In order to conduct the DPM Feasibility Study for St. Louis, a two phase, fifteen task study approach was used. The two phases are: Phase I-System Analysis and Evaluation and Phase II-Preliminary Systems Plan.

Phase I assesses the economic and social feasibility of DPM technology in the downtown St. Louis-East St. Louis area through a total of seven (7) analytical tasks. These tasks are:

- Define objectives of a DPM system
- Alternative Configuration Analysis
- Bus Analysis
- Community Interaction Plan
- Transit Demand Analysis
- Preliminary Alternatives and Costs
- Trade-Off Studies - Selection of Optimum DPM Configuration

The results of these tasks are to be reviewed by various concerned agencies and then a decision will then be made on proceeding with Phase II.

Phase II involves the detailed technical analysis of the selected DPM system required to expedite preliminary engineering. Specific Phase II tasks include:

- Preliminary Performance Specifications
- Preliminary System Cost Estimates
- Fringe Parking/Intercept Proposal
- Bus Plan
- Financial Plan
- Preliminary Environmental Impact Assessment Plan
- DPM Program Management Plan
- Final Work Program/Schedule and Final Report

TECHNICAL REVIEW COMMITTEE

In order to insure community involvement in this study, a Technical Review Committee (TRC) was established to assist the Project Team and provide review

at specified milestones in the study process. The TRC is composed of the following agencies:

- City of St. Louis
 - Mayor's Office
 - Community Development Agency
 - Street Department
- City of East St. Louis
 - Mayor's Office
- East-West Gateway Coordinating Council
- Downtown St. Louis, Inc.
- Regional Commerce and Growth Association

In addition to their review function, the principle task of the TRC was to develop and rank the goals and objectives for the project. Goals and objectives are discussed in Chapter II.

COMMUNITY INTERACTION PROGRAM

The DPM Feasibility Study included a Community Interaction Plan (CIP) designed to provide communication channels to disseminate information and receive citizen input. The CIP consisted of four components:

- Public Meetings;
- Presentation to Transportation Related Organized Groups;
- Development of a Community Advisory Board; and
- Media Releases

PUBLIC MEETINGS

Two public meetings were planned during Phase I of the Project. Public meetings were open to any concerned citizen and conducted in a manner that provided individual attendees the opportunity to respond in verbal and written format. The initial public meeting was held on February 28, 1980, at the Cervantes Convention Center. At that meeting, attended by approximately thirty (30) people, the topic discussed was the DPM Goals and Objectives and System Technology. The second meeting will be scheduled at the conclusion of Phase I.

DEVELOPMENT OF A COMMUNITY ADVISORY BOARD

In order to receive input from the community that will be affected by development of a DPM system, a Community Advisory Board (CAB) was established. This group provided input for the potential user community and aided in identification of possible conflicts. The CAB was composed of representatives of the business community, government agencies, and various organized interest groups. Membership included the following:

Government Agencies

Federal Executive Board

St. Louis Mayor's Office

Community Development Agency - City of St. Louis

Business Groups

Downtown St. Louis, Inc.

Mayor's Economic Development Advisory Committee

Civic Progress, Inc.

Civic Center Redevelopment Corporation

May Company

Building Owners and Managers Association

Southwestern Bell Telephone Company

Citizen Groups

East-West Gateway Regional Forum

Coalition for the Environment

Preservation Alliance

ACORN

Landmarks Association of St. Louis

Urban League

City Landmarks and Urban Design Commission

League of Women Voters

A meeting was held with the CAB during the first week of March, 1980, with approximately twenty (20) persons attending. The material presented was identical to that of the Public Meeting.

MEDIA RELEASES

One news release was made; before the Public Meeting in late February. Listed below are the print media which were contacted:

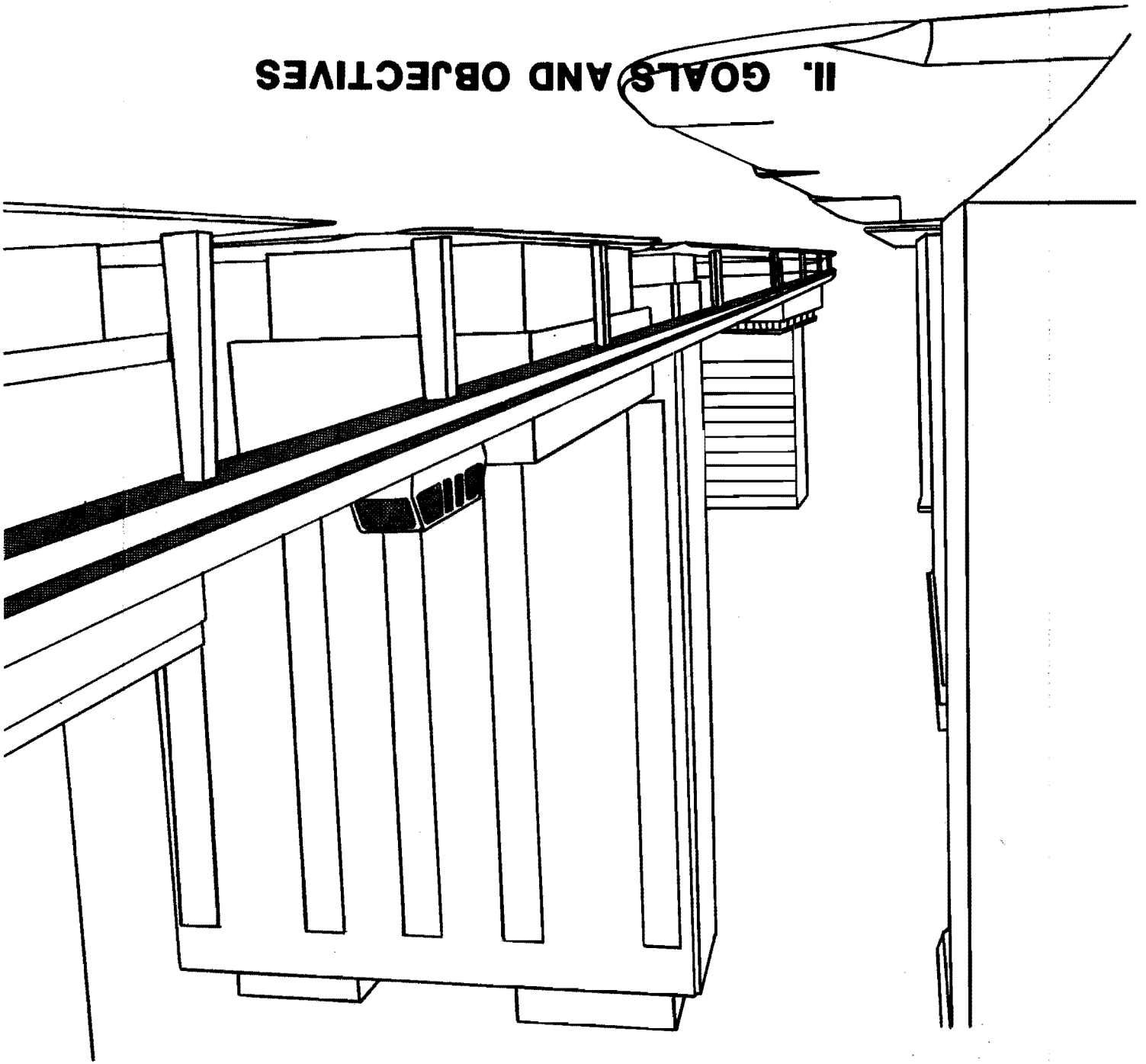
St. Louis Post-Dispatch

St. Louis Globe-Democrat

Downtowner Newspaper

The Riverfront Times

II. GOALS AND OBJECTIVES



II. GOALS AND OBJECTIVES

In order to provide direction and guidance for the development of concepts and alternative alignments with regards to a DPM for Metropolitan St. Louis, a list of goals and objectives were identified. The establishment of goals and objectives early in the project was necessary in order to facilitate the many decision-making activities involved in determining the alternative alignments to be analyzed.

FORMULATION OF GOALS AND OBJECTIVES

The Project Team developed a list of goals and objectives which were presented to members of the Bi-State Staff, reviewed and then presented to the TRC of the DPM feasibility study.

The presentation of the goals and objectives to the TRC on December 6, 1979, involved discussing the need for establishing these categories, how they would be used in the evaluation process, and how these goals and objectives were to be used in the overall feasibility study. Following is the list of goals presented to the TRC:

- Promote economic development
- Promote land use development in conjunction with transportation development
- Improve CBD environmental quality
- Improve CBD transportation system
- Optimize system cost
- Optimize social impact

The Project Team further defined the goals by delineating objectives and sub-objectives for each goal. During the last week in December, 1979, evaluation forms were distributed to members of the TRC. These forms (sample shown in Appendix A) listed the goals, objectives, and sub-objectives with a

scale of 1-10 for each item. The person completing the form was instructed to evaluate each item listed.

RESPONSES

The evaluation of the goals and objectives was based on the responses from each of the agencies/groups responding. If a particular agency or group had more than one person completing an evaluation form, the mean value was used for the agency or group, thereby providing each agency or group with equal weight in the ranking process. The actual ranking process involved three steps: (1) determining the numerical number for each item, (2) calculating, and (3) listing the goals and objectives in order of ranking. The numerical determination for goals occurred by assigning a value to the scale as marked (possible 10). For the objectives, the value from the scale (for that item) was multiplied by the value assigned to that goal, under which that objective was located ($10 \times 10 = \text{possible } 100$).

Once the numerical values were assigned, descriptive statistics were calculated to provide information about the data collected. The descriptions calculated were:

- Sum of Scores
- Range
- Mean
- Truncated Mean
- Median

The range was useful in identifying the disparity between the different agencies and groups with respect to an individual item. Where concurrence was noted, the range was narrower. The actual ranking was accomplished utilizing the mean values. The truncated mean and median were refinements utilized to evaluate those rankings which were numerically similar.

Rankings of Goals and Objectives

During the January 10, 1980, TRC meeting, the results of the responses received were presented. Table 1 shows the rankings of goals and objectives in descending order of importance. A histogram, Figure 4, was presented in order to illustrate the relative values of the items that were ranked. The results of the calculated values are listed in Appendix A.

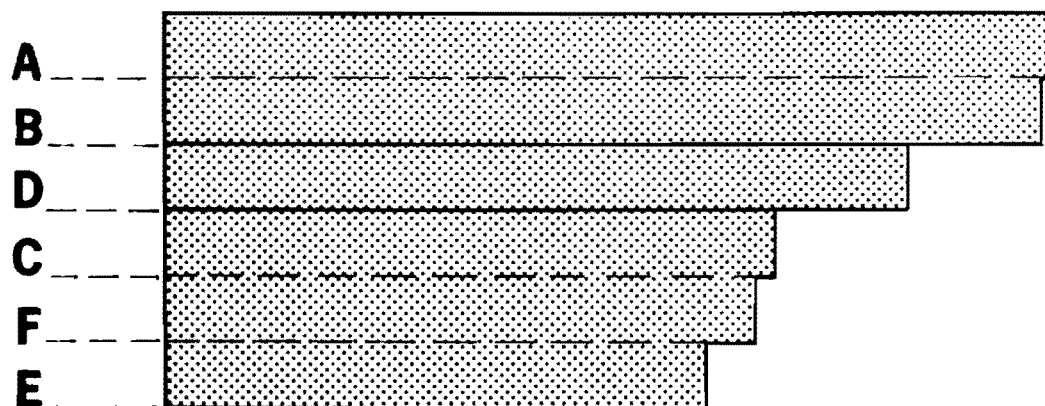
Results and Summary

The goals and objective process resulted in the establishment of goal rankings as presented in Table 1. The two top items in the goals and objectives relate to improving economic development and promoting land use development; the goal ranked last deals with optimizing system cost. The assumption can be made that a DPM system in St. Louis should be developed not necessarily for optimization of social or cost effectiveness but to bring about economic development to the St. Louis CBD in conjunction with improved transportation services. The goals and objectives were used throughout the study to evaluate the effectiveness of each alternative. Chapter V describes this process in detail.

ST. LOUIS DPM GOALS & OBJECTIVES-RANKING

0 1 2 3 4 5 6 7 8 9 10

Goals



Objectives

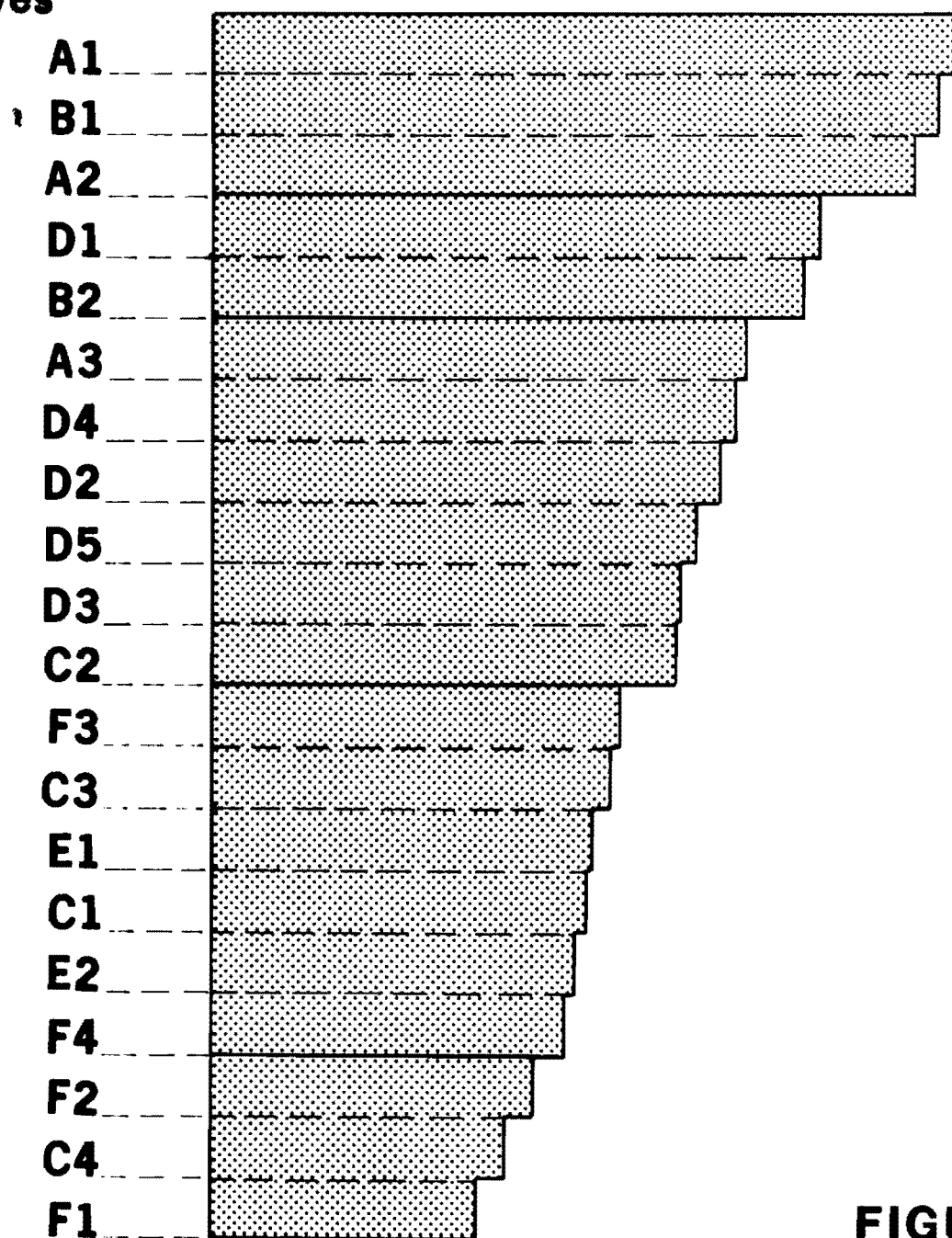


FIGURE 4

TABLE 1

ST. LOUIS DPM GOALS AND OBJECTIVES
RANKED BY ORDER OF IMPORTANCE

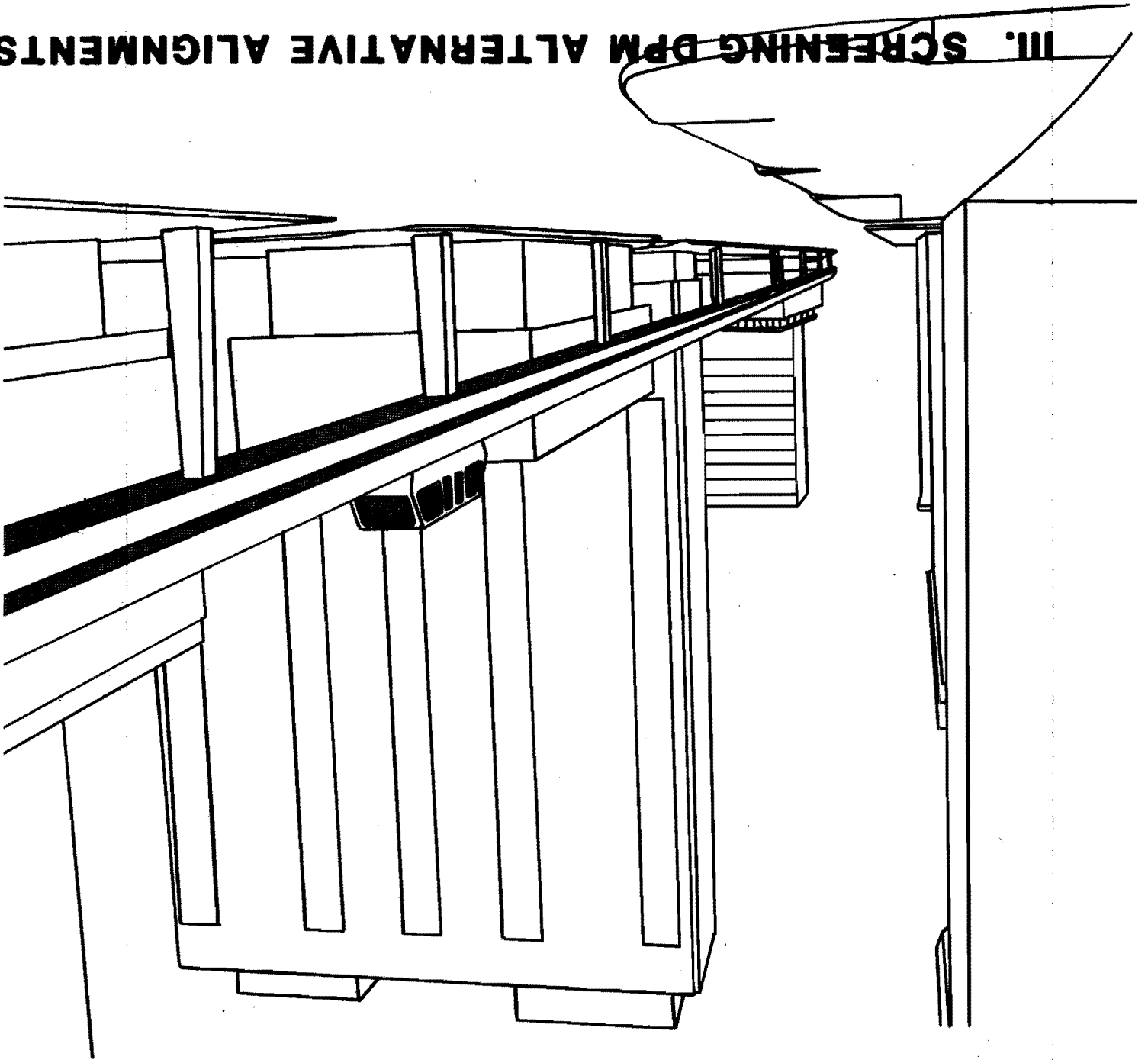
GOALS

- A - Promote Economic Development
- B - Promote Land Use Development in Conjunction with Transportation Development
- D - Improve CBD Transportation System
- C - Improve CBD Environmental Quality
- F - Optimize Social Impact
- E - Optimize System Cost

OBJECTIVES

- A1 - Complement existing and planned development
- B1 - Promote orderly and more desirable forms of land use
- A2 - Stimulate new development
- D1 - Improve access between CBD activity centers (circulation)
- B2 - More efficient and rational use of scarce urban land
- A3 - Promote energy conservation
- D4 - Integration of existing and future transportation systems
- D2 - Improve regional access to CBD (distribution)
- D5 - Provide access to areas of greatest development potential
- D3 - Improve regional public transit service
- C2 - Encourage aesthetic quality of CBD
- F3 - Expansion of evening and weekend activities
- C3 - Reduce traffic congestion
- E1 - Lowest cost/trip for majority of potential transit users
- C1 - Improve environmental quality of CBD
- E2 - Maximize cost effectiveness
- F4 - Matching of impacts and benefits across economic and geographic sectors
- F2 - Minimize community (neighborhood) disruption
- C4 - Minimize construction impacts
- F1 - Provide service to the transportation handicapped

III. SCREENING DPM ALTERNATIVE ALIGNMENTS



III. SCREENING DPM ALTERNATIVE ALIGNMENTS

OVERVIEW OF THE PROCESS, ASSUMPTIONS, AND CRITERIA

The intent of the Project Team was to use the goals and objectives set forth by the TRC to establish the alignment for the people mover in St. Louis. Based on the goals and objectives, an initial set of routes were developed, setting forth the advantages and disadvantages of each, with respect to "value capture, urban design, and engineering." These initial routes were evaluated by the TRC and in turn, additional alignments or modifications suggested. Finally, four basic alignments evolved. These four alignments will be discussed in detail in Chapter IV.

The following assumptions were made prior to the development of the initial routes:

- Some type of regional Light Rail Transit System would be recommended
- 1985 would be the design year
- TIP/TSM activities would be on-going

As shown in Chapter II, physical and economic development activities were rated higher by the TRC than the three issues of environmental quality, social, impacts, and optimizing the systems cost. Other criteria used in alignment development included:

- Two block, 1,600 foot walkshed to DPM stations
- Connect major activity areas with parking lot/structures
- Interface with the developing sky-walk system

INITIAL ROUTE OPTIONS CONSIDERED

Utilizing the assumptions and criteria previously noted, ten initial route options were developed and presented to the TRC for their evaluation.

Following is a description of each route. Figures depicting each route and tables addressing the advantages and disadvantages of each route follow the route descriptions.

ROUTE OPTION A

Route Option A, shown in Figure 5, is the original alignment proposed in the 1976 DPM application prepared by CDA. It extends from Laclede's Landing on the east to Union Station on the west and Cole Street on the north to U.S. 40 on the south. The route would be a double guideway loop and would operate through the existing downtown tunnel under Eighth Street and Washington Avenue. Table 2 lists some of advantages and disadvantages of this option.

ROUTE OPTION B

Option B, is shown in Figure 6, is a two-way shuttle entirely on an elevated guideway. The route extends from Union Station north to Chestnut Street, east to Eighth Street, north to Convention Plaza, east to Third Street, south to Washington and east to Second Street. Because the route is elevated along Eighth Street, there would be no conflict with any potential use of the tunnel by a regional light rail system. Table 3 presents some of the potential advantages and disadvantages of this option.

ROUTE OPTION C

This option is shown in Figure 7 and could be operated as either a one-way or two-way loop, although construction of a two-way guideway along a narrow street such as Olive would be difficult and cut off most of the sun light from the pedestrian areas. The route utilizes Chestnut, Olive and Seventh Streets in the core and Convention Plaza and Fourth Street on the north and east. Table 4 presents some of the advantages and disadvantages of the option.

ROUTE OPTION D

This option is similar to Route Option B except that Olive Street is used instead of Chestnut east of Eighteenth Street and Sixth Street is used instead of Eighth Street south of Convention Plaza. This brings the route further east into the core area. Table 5 presents some of the advantages and disadvantages of the option and it is shown in Figure 8.

ROUTE OPTION E

This option attempts to tie together the northwest and southeast segments of the downtown. It operates as a double guideway two-way shuttle along Delmar Boulevard; Sixteenth, Locust, and Pine Streets; and Memorial Drive. It crosses several pieces of property which presently have structures on them. This could be a substantial problem in the connection between Locust and Pine Streets at Eleventh Street and crossing Stouffer's Riverfront Towers between Memorial Drive and Fourth Street. Table 6 presents some of the advantages and disadvantages of this option and Figure 9 presents the option.

ROUTE OPTION F

Route Option F is a "collapsed" Route Option A in that the boundaries of the alignment are brought closer together along the south side of the downtown. It would operate as a two-way double guideway loop. A two block "notch" is provided between Broadway and Seventh Street to bring the route closer to the core. Some of the potential advantages and disadvantages of this alignment are presented in Table 7 and the option is presented in Figure 10.

ROUTE OPTION G

Option G is basically two small loops with a common leg along Eighth Street. The route could operate as either a one-way loop, two separate loops, a figure "8", or a double guideway two-way route. Some of the advantages and

disadvantages of this alignment are presented in Table 8 and the option is shown in Figure 11.

ROUTE OPTION H

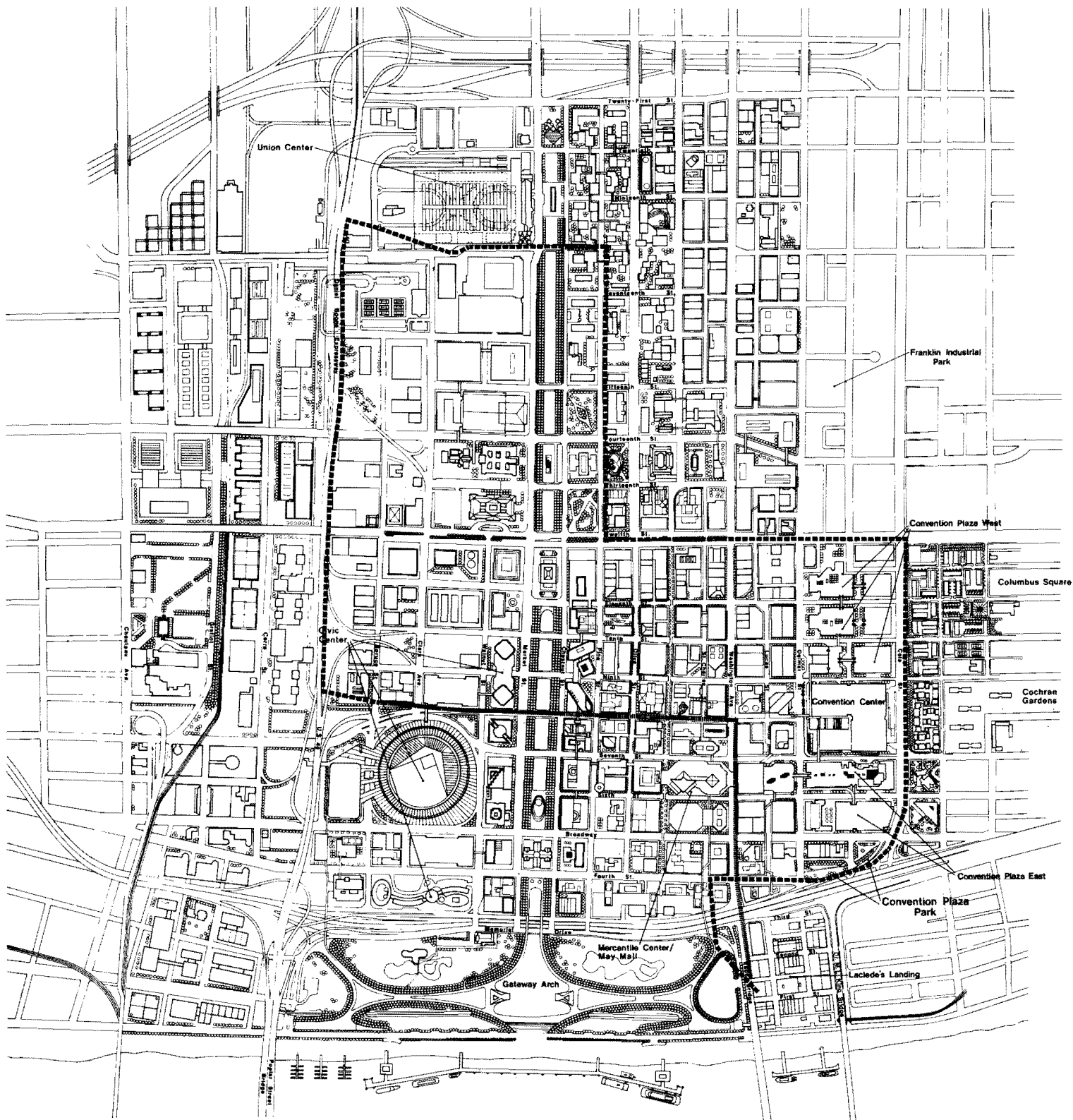
Option H is actually two routes which intersect at Ninth and Olive Streets. Both routes would have to operate as double guideway, two-way shuttle with a transfer point at the intersection of the two routes. Table 9 presents some of the potential advantages and disadvantages of this option and Figure 12 presents the option.

ROUTE OPTION I

Option I is basically a loop with a tail shuttle on it providing access to the southwest area of the downtown west of Eighth Street and is shown in Figure 13. The loop portion can be operated as a single, one-way guideway with the tail being a double guideway shuttle. Table 10 presents some of the potential advantages and disadvantages.

ROUTE OPTION J

Option J is a simple "L" route using Market and Sixth Streets and is shown in Figure 14. It would operate as a double guideway two-way shuttle. The advantages and disadvantages of this route are presented in Table 11.



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Booker / Bernard Johnson

Legend

- Primary Route/Above Ground
- Primary Route/Tunnel

ROUTE OPTION A

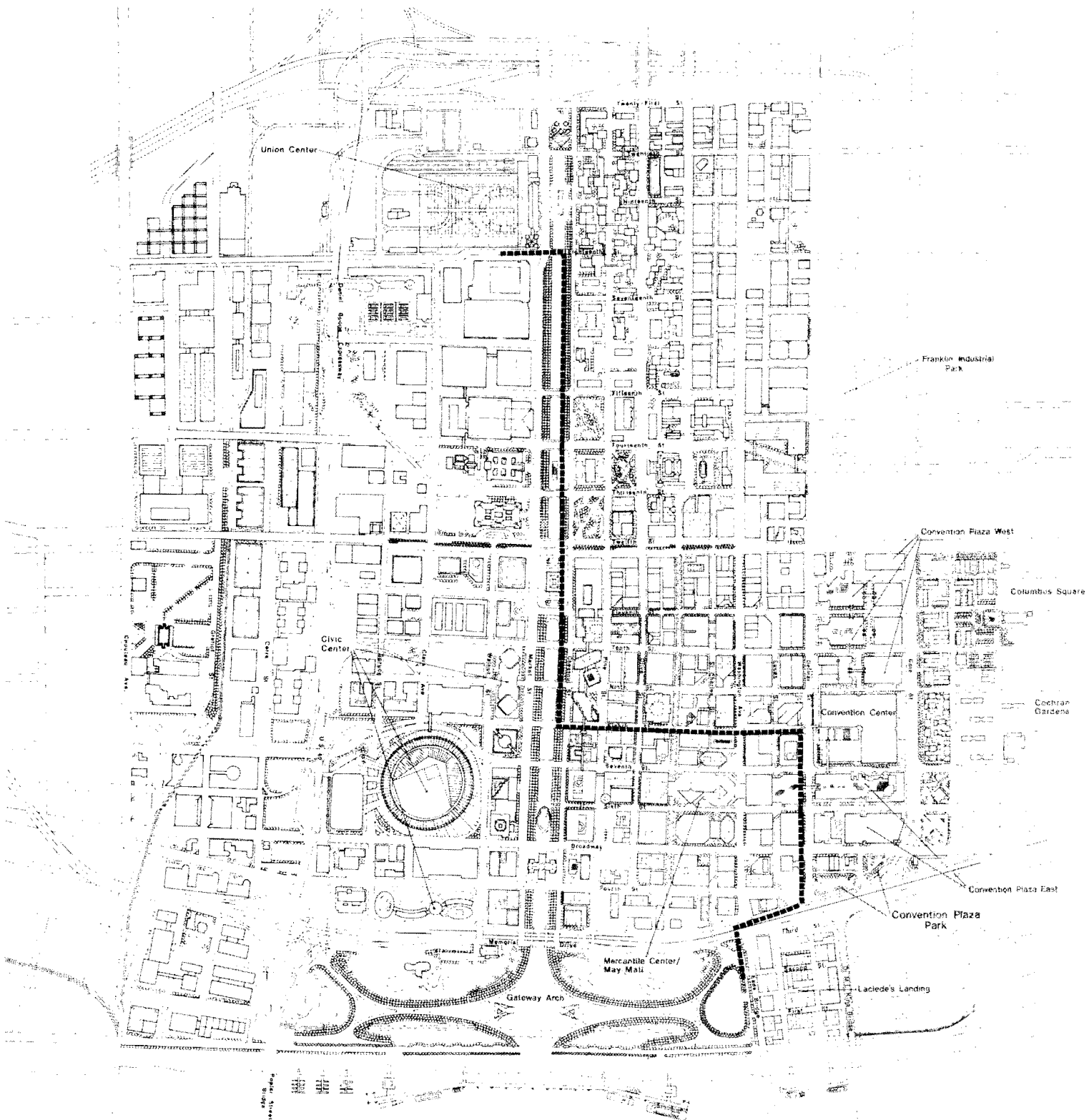
Figure 5

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri



TABLE 2
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION A
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Connects convention center with some hotels, entertainment, office and retail areas. ● Could make May Mall eligible for UMTA funds. ● Would spur new development along north side of Gateway Mall from Tucker Boulevard to 18th Street ● Connection to light rail at Union Station could spur development.	● Use of tunnel reduces core area conflicts. ● Promotes peripheral parking strategy. ● Little conflict with Gateway Mall. ● Access to historic buildings without visual interference. ● Potential for incorporating into 8th Street Transit Mall.	● Uses existing tunnel and adjacent U.S. 40 R.O.W. ● Southern half of route could be built at less cost than elevated.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● Misses government offices along Market Street. ● Does not provide access to hotel concentration north and east of stadium.	● Could conflict with historic buildings in Laclede's Landing and Union Station. ● Must cross Gateway Mall twice.	● Longest and most expensive route. ● First segment would have little visibility. ● Possible tunnel conflict with light rail system. ● Possible conflict with I-70. ● Long travel times for east-west trips within core.



Downtown People Mover Feasibility Study

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Legend

----- Primary Route

ROUTE OPTION B

Figure 6

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri



TABLE 3
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION B
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Spurs development of northern half of Gateway Mall and could free UMTA funds for mall completion. ● Connects convention center with major developments like Laclede's Landing, May Mall, and Union Station. ● Potential opportunities for second story office space as in-kind match. ● Links DPM with Arcade Building and Old Post Office. ● Promotes development of convention plaza east area.	● Elevated design frees tunnel for light rail. ● Can be linked to Eads Bridge.	● Short route results in better headways. ● Could be extended to East St. Louis ● Elevated route could link with skywalk system. ● Buildings on north side of gateway and convention plaza east area could incorporate DPM into design.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● No east-west movement through core area. ● No connection with Busch Stadium complex. ● No access to hotels north and east of Stadium.	● Could disrupt visual continuity of Gateway Mall. ● Potential visual conflicts with state office complex and Old Post Office.	● Potential conflicts with I-70. ● Possible design problems over 8th Street tunnel. ● Possible problem of double guideway along narrow core streets.

Figure 7

Downtown People Mover Feasibility Study

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Legend
Primary Route

ROUTE OPTION C

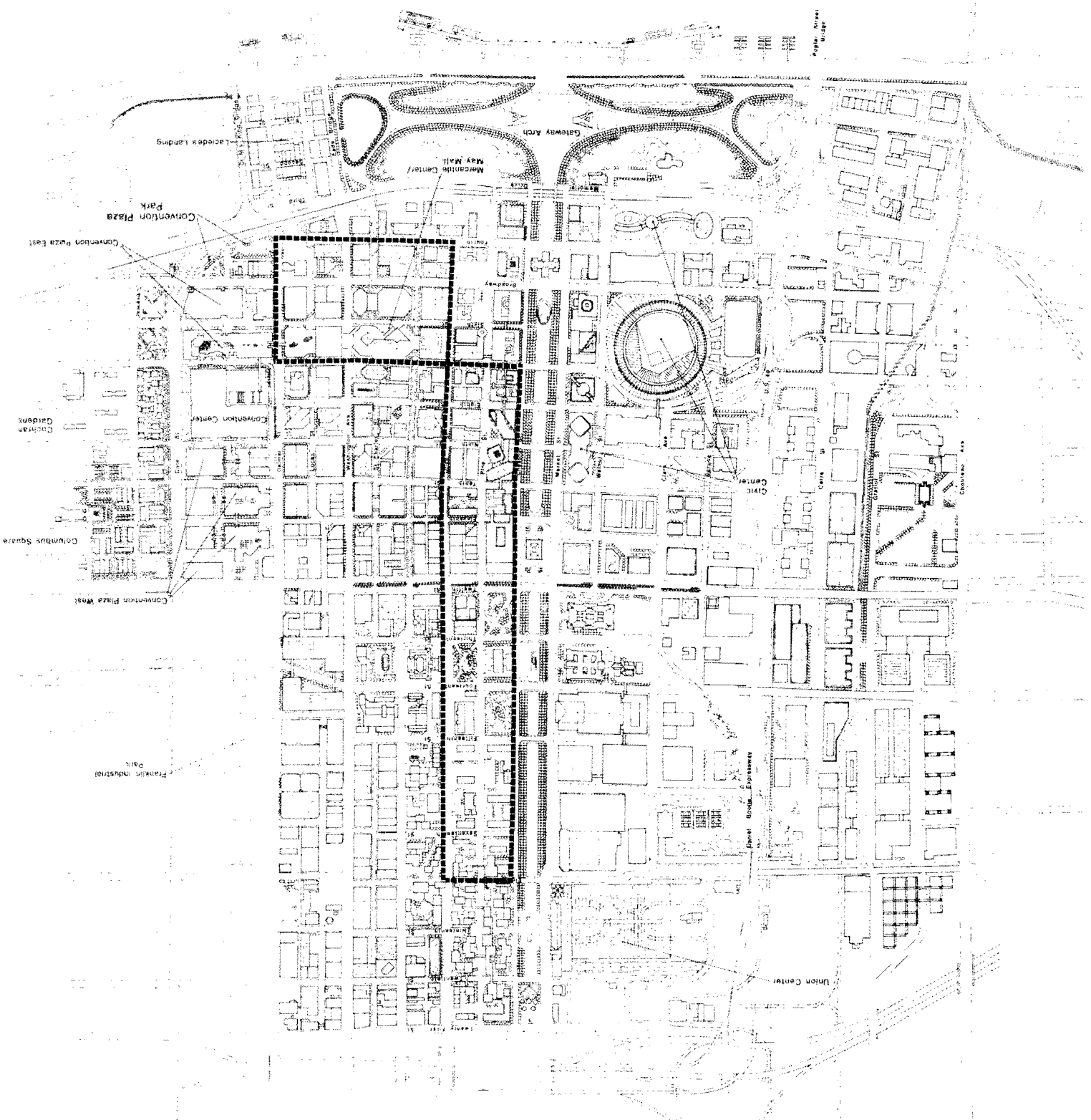
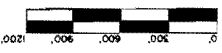


TABLE 4
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION C
POTENTIAL ADVANTAGES AND DISADVANTAGES

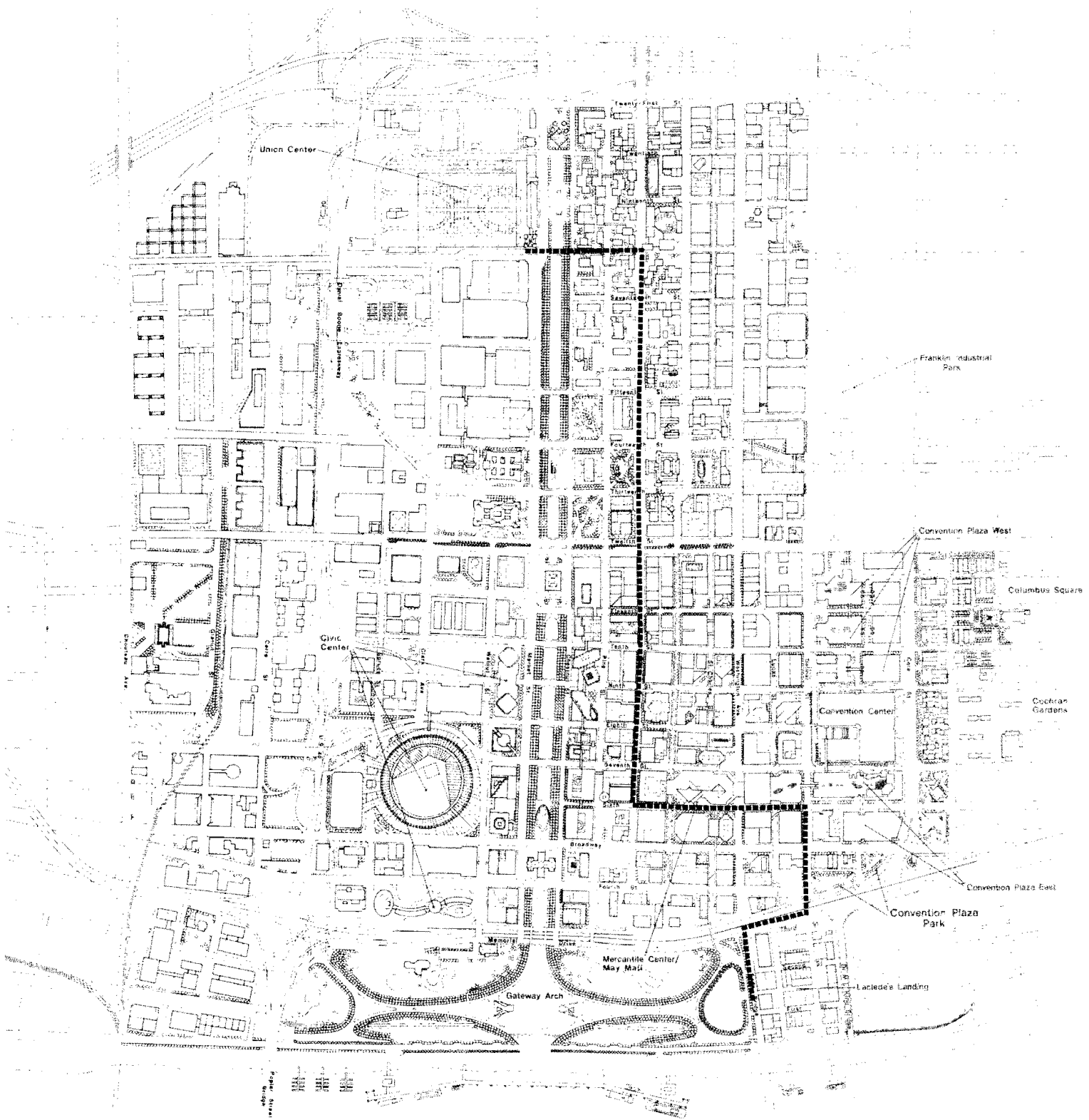
<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Spurs development of northern half of Gateway Mall and could free UMTA funds for mall completion. ● Connects convention center with major developments like Laclede's Landing, May Mall, and Union Station. ● Potential opportunities for second story office space as in-kind match. ● Links DPM with Arcade Building and Old Post Office. ● Promotes development of convention plaza east area. ● High value-capture potential along Olive & 4th Streets. ● Potential for serving greatest number of people.	● Elevated design frees tunnel for light rail. ● Can be linked to Eads Bridge.	● Utilities widest downtown streets. ● Frees tunnel for light rail vehicles.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● No direct link to Laclede's Landing or Arch parking. ● No direct link with Union Station. ● No connection to Busch Stadium complex.	● Most obtrusive configuration. ● Could disrupt visual continuity of Gateway Mall. ● Potential visual conflicts with state office complex and Old Post Office.	● Most expensive due to elevated nature. ● Problem with loop intersect at 7th & Olive Streets. ● Possible problem of double guideway along narrow core streets.

Disadvantages

- Routes along Chestnut and Olive Streets may be too close.
- No link to hotels north and east of Stadium.
- Would not stimulate development south of Gateway Mall.

Disadvantages

Disadvantages



Downtown People Mover Feasibility Study

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Legend

----- Primary Route

ROUTE OPTION D

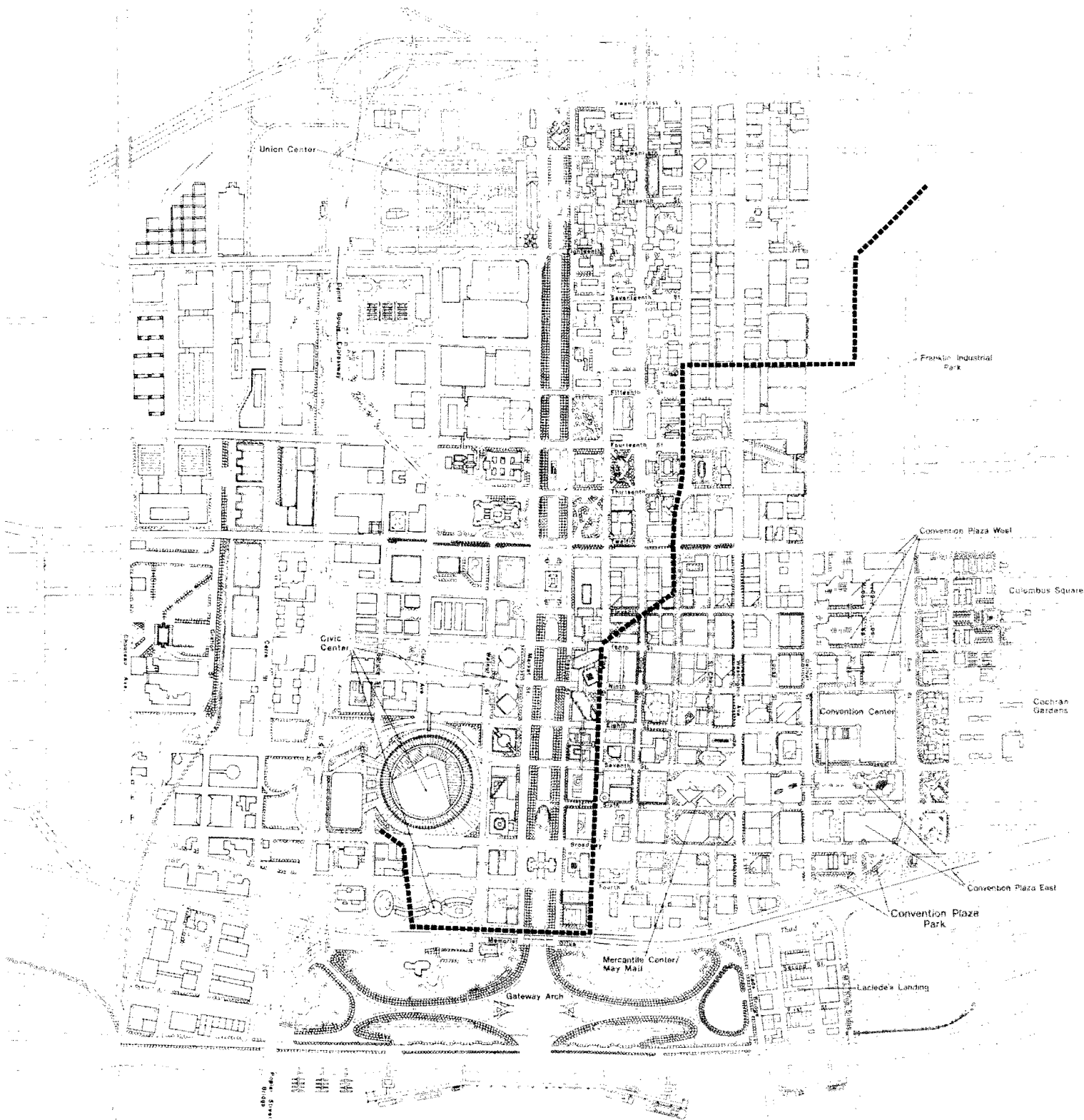
Figure 8

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri



TABLE 5
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION D
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Direct connection to May Mall development. ● Links DPM with Arcade Building and Old Post Office. ● Promotes development of convention plaza east area.	● No visual conflict with Gateway Mall. ● Can be incorporated into May Mall.	● Frees tunnel for light rail. ● Could be extended to East. St. Louis.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● No direct links to convention center. ● Little impact upon development of north side of Gateway Mall. ● No link to hotels north and east of Stadium. ● Would not stimulate development along either side of Gateway Mall.	● Possible conflict with Old Post Office.	● Potential conflict with I-70. ● Possible problem of double guideway along narrow core streets.



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Legend

----- Primary Route

ROUTE OPTION E

Figure 9

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

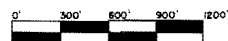
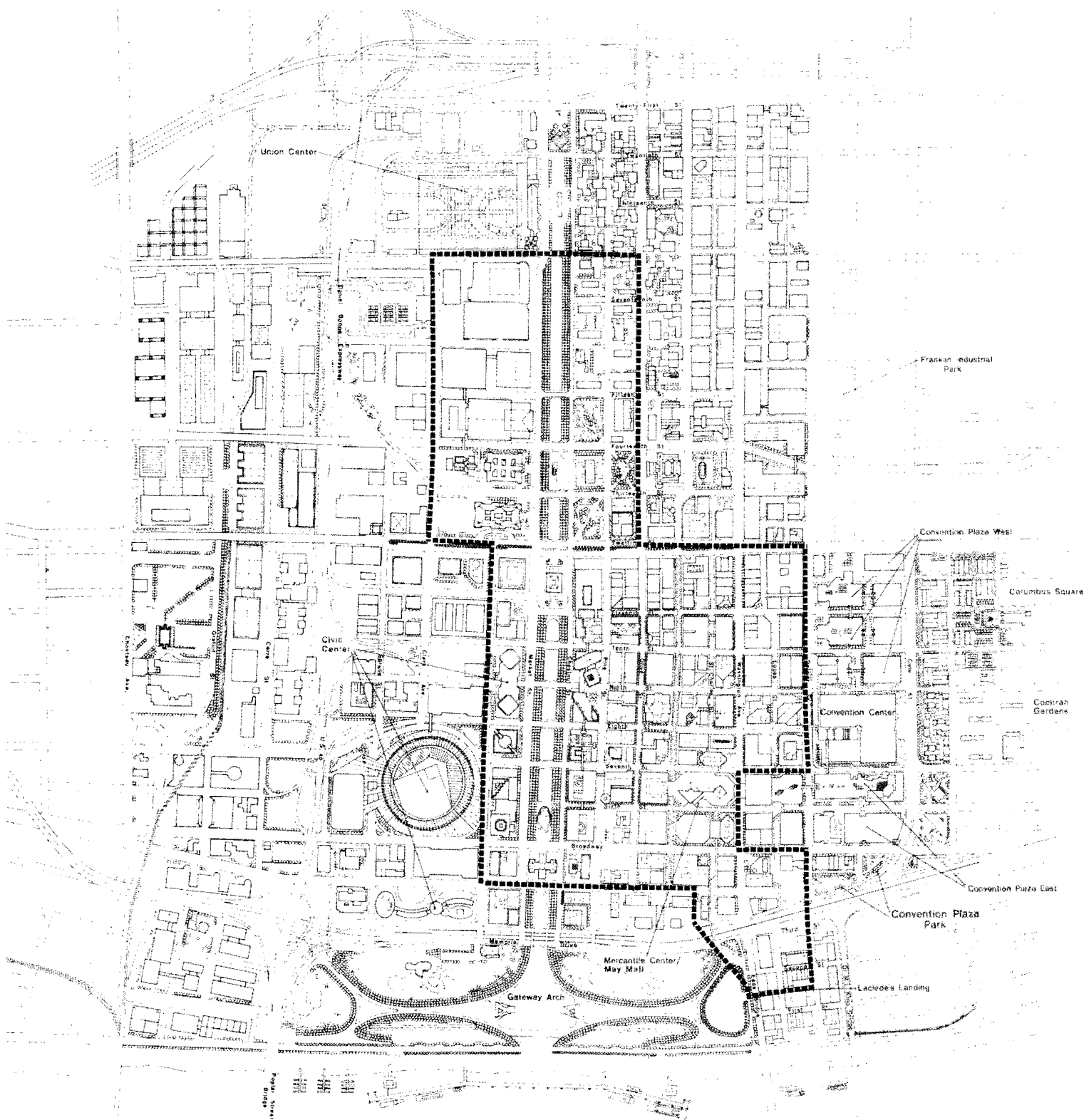


TABLE 6
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION E
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
• Connects Centrum to Central Business District. • Promotes Washington Avenue loft district redevelopment. • Light rail and DPM stations should encourage Arcade Building.	• Could be linked to Famous-Barr and stadium-east garage. • Promotes peripheral parking strategy in the northwest and southeast areas of the core.	• Alternative route frees tunnel for light rail. • Should result in relatively low headways.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
• Misses Convention Center Plaza activity center. • Depends upon existence of light rail line for its success. • Misses government workers along Market Street. • Would not promote development along Gateway Mall or Convention Plaza areas. • No connection possibilities to Laclede's Landing.	• Potential conflict with Christ Church Cathedral. • Crosses Gateway Mall in front of Arch. • Potential problems with crossing from Pine to Locust Street.	• Difficult to develop an East St. Louis link. • Potential problem of crossing property with existing, new buildings. • Possible problem of double guideway along narrow, core streets.



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Legend

----- Primary Route

ROUTE OPTION F

Figure 10

Base Map Courtesy of:
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St. Louis, Missouri

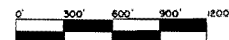


TABLE 7
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION F
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
• Connects all major CBD activity areas. • Would spur development activity pace south of Walnut Street and north of Convention Plaza. • Could enhance upgrading of Washington Avenue Loft area to Olive Street. • Could spur development south of Clark Street at Government Center.	• Promotes peripheral parking strategy. • Could link to skyway walk system. • Doesn't intrude along Gateway Mall. • Accesses many historic buildings.	• Intersects major bus stops. • Frees tunnel for light rail.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
• May not intensify core activity. • Doesn't intrude into densest part of core.	• Must cross mall in three locations. • Intrudes into Laclede's Landing, Mansion House.	• Long route, would be expensive. • Must be two-way loop to be efficient. • Provide no access to densest part of CBD. • Potential conflict in Laclede's Landing and with I-70.

Figure 11

Downtown People Mover Feasibility Study

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Primary Route

Legend

ROUTE OPTION G

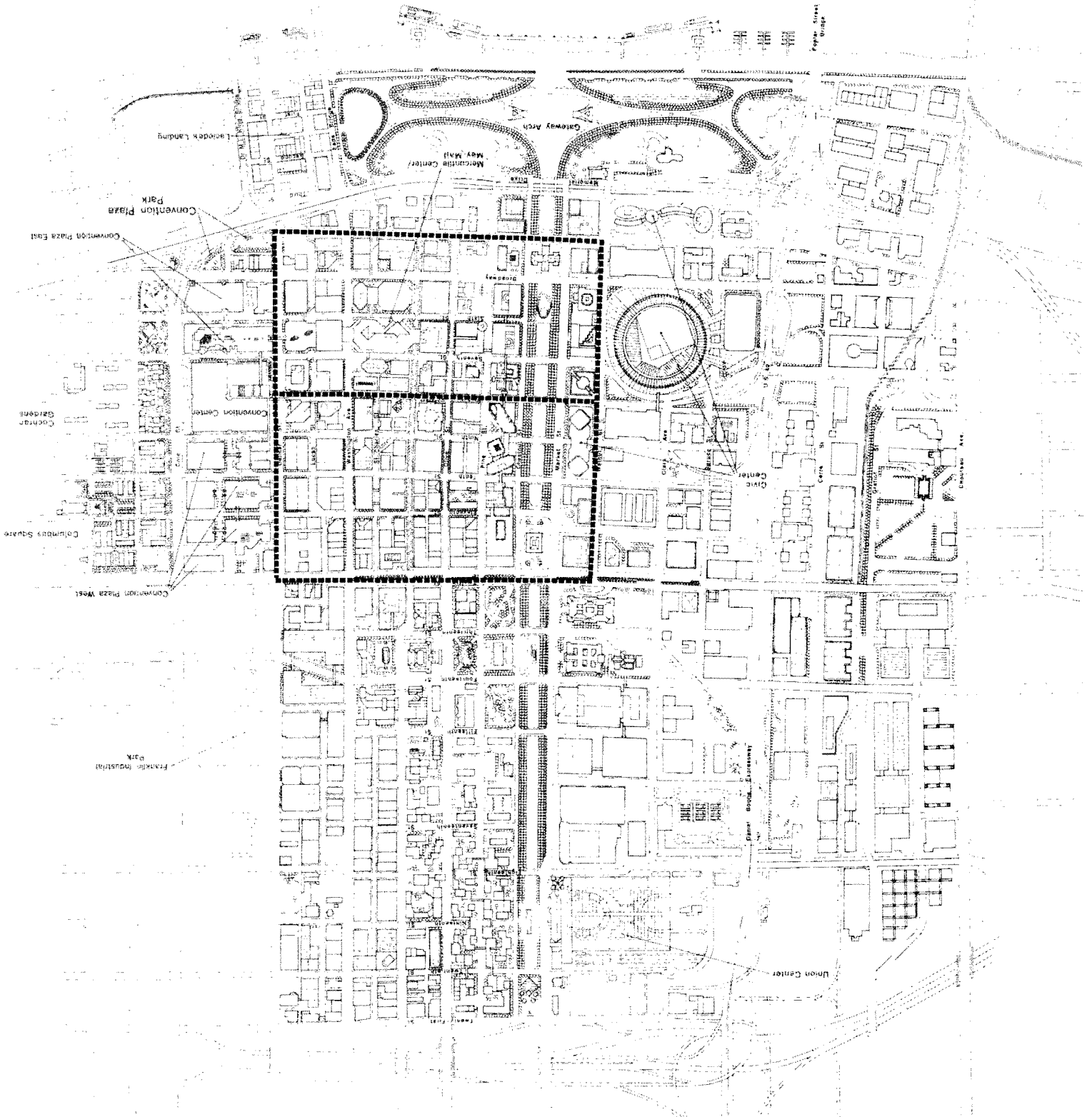
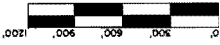
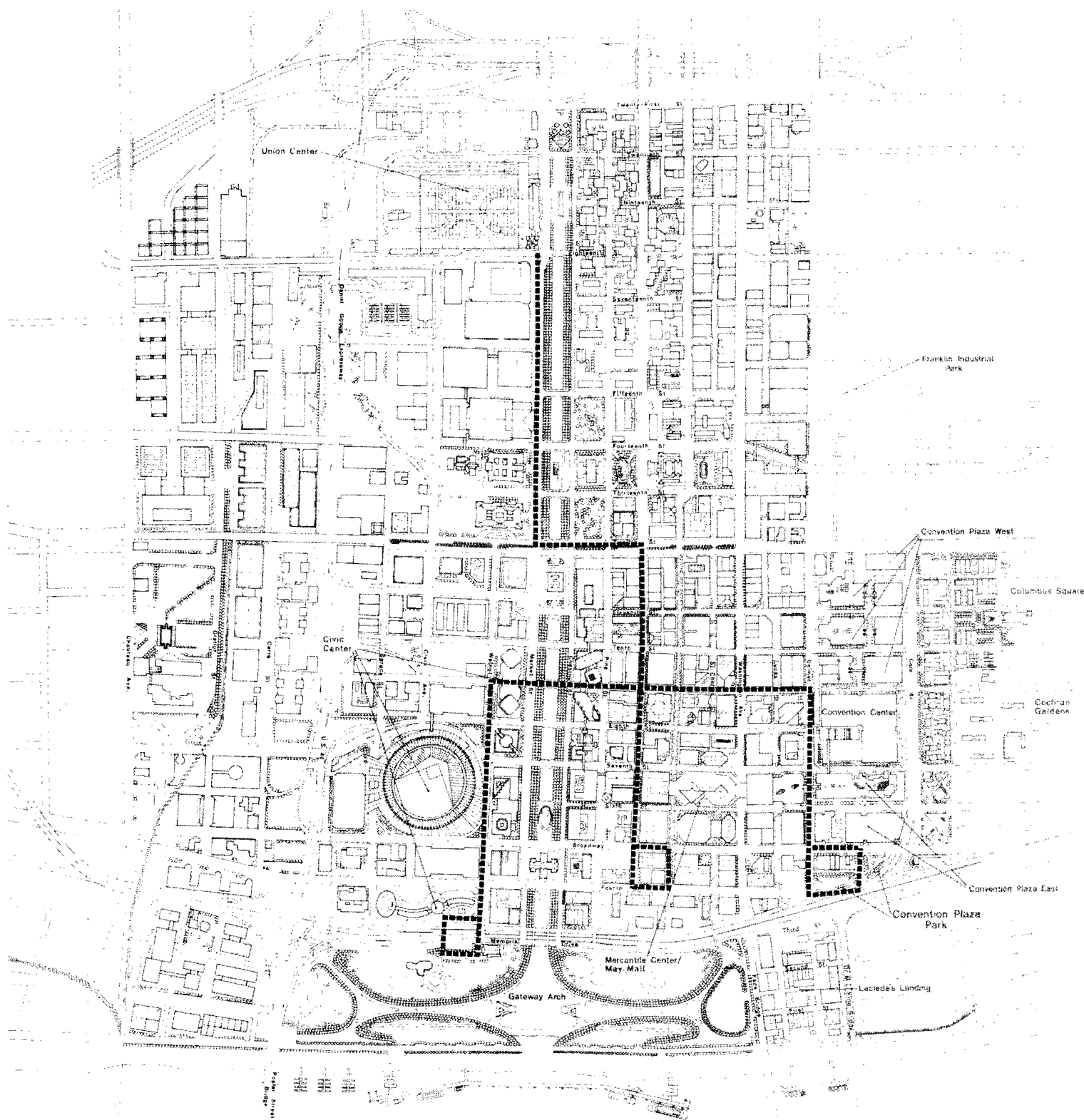


TABLE 8
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION G
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Connect all activity nodes east of 12th Street. ● Would promote development south of Walnut to north of Delmar. ● Could spur development along 12th Street. ● Could free UMTA funds for May Mall. ● Could intensify Core Activity along 8th Street.	● Promotes fringe parking east of 12th. ● Could link to skywalk system. ● Focuses activity east of 12th and at 2 nodes; at Stadium and Convention Center.	● Fairly compact route, few turns. ● All but two legs on wide streets. ● Frees tunnel for light rail. ● Good Core access along 8th.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● Misses government Union Center west of 12th Street. ● Barely touches Washington Avenue Loft area.	● Crosses Gateway Mall at three points between 4th and 12th. ● Could conflict with buildings in Laclede's Landing. ● Possible conflict with Old Post Office.	● Route should be two-way for optimum use. ● No east-west movement through densest part of Core. ● Potential conflict with I-70 and Laclede's Landing. ● Possible design problem over tunnel.



Downtown People Mover Feasibility Study

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Legend

----- Primary Route

ROUTE OPTION H

Figure 12

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

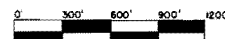


TABLE 9
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION H
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Connects all CBD activity centers. ● Could spur development south of Walnut Street and north of Convention Plaza. ● Could intensify Core development along 9th and Olive Streets. ● Connection with light rail at Union Center could spur development.	● Little conflict with Gateway Mall. ● Promotes fringe parking. ● Intensifies existing development patterns. ● Concentrates activity around Old Post Office. ● Could tie into skywalk system. ● Minimal intrusion into Laclede's Landing.	● Simple routing: 2 routes. ● Can be built in stages and still be useful. ● Provides both east-west and north-south Core access. ● Frees tunnel for light rail. ● Headway can be more frequent due to 2 Route system.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● Misses Washington Avenue Loft District north 12th Street.	● Crosses Mall at 2 locations. ● Provides visual barrier between Government Complex ● Possible visual obstructions along Olive Street.	● 2 routes, requires transfer. ● 9th and Olive crossing difficult to construct. ● Possible conflict with I-70. ● Potential problem of double guideway along narrow core streets.

Figure 13

Downtown People Mover Feasibility Study Booker / Bernard Johnson

Primary Route

Legend

ROUTE OPTION I

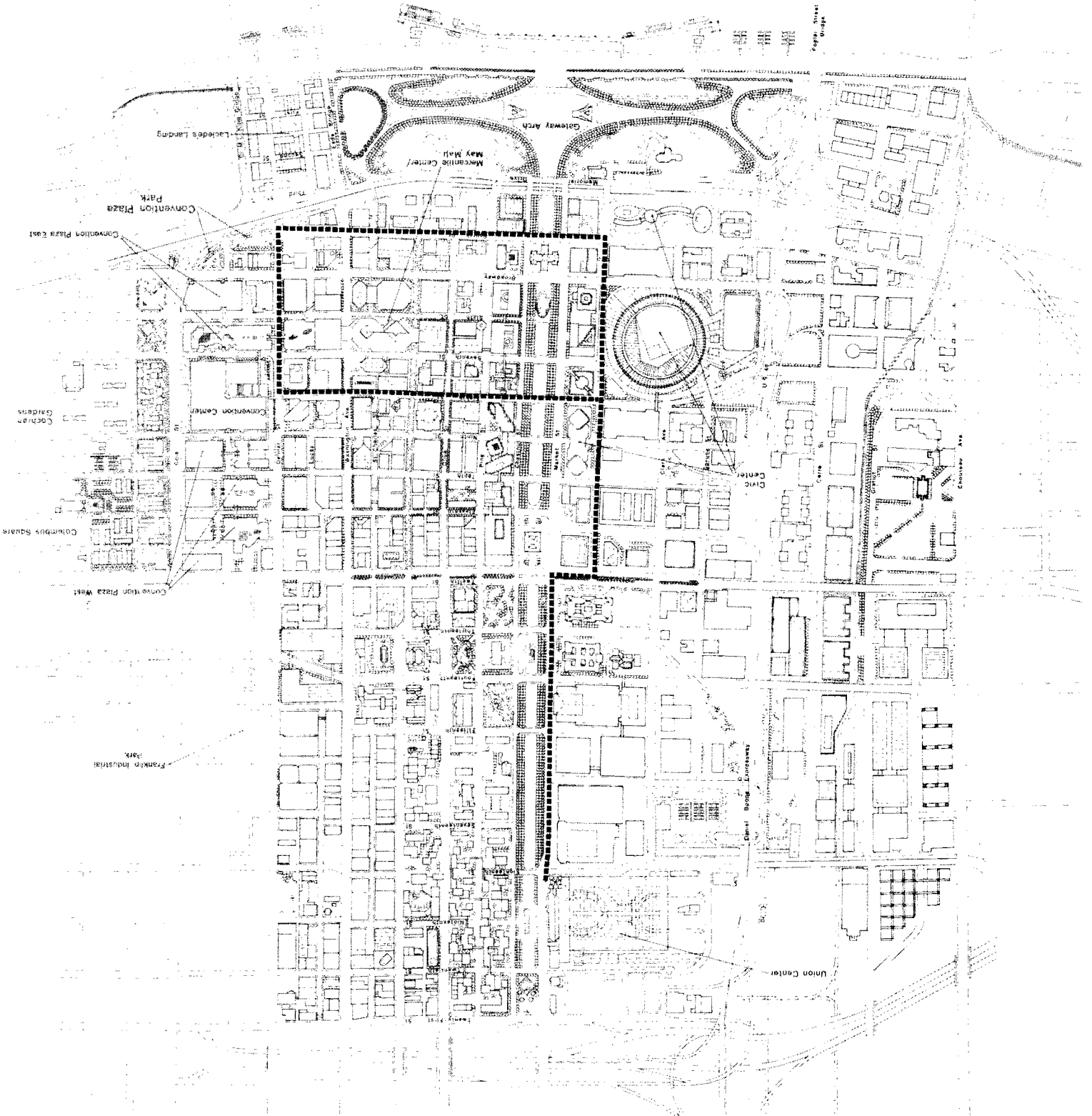
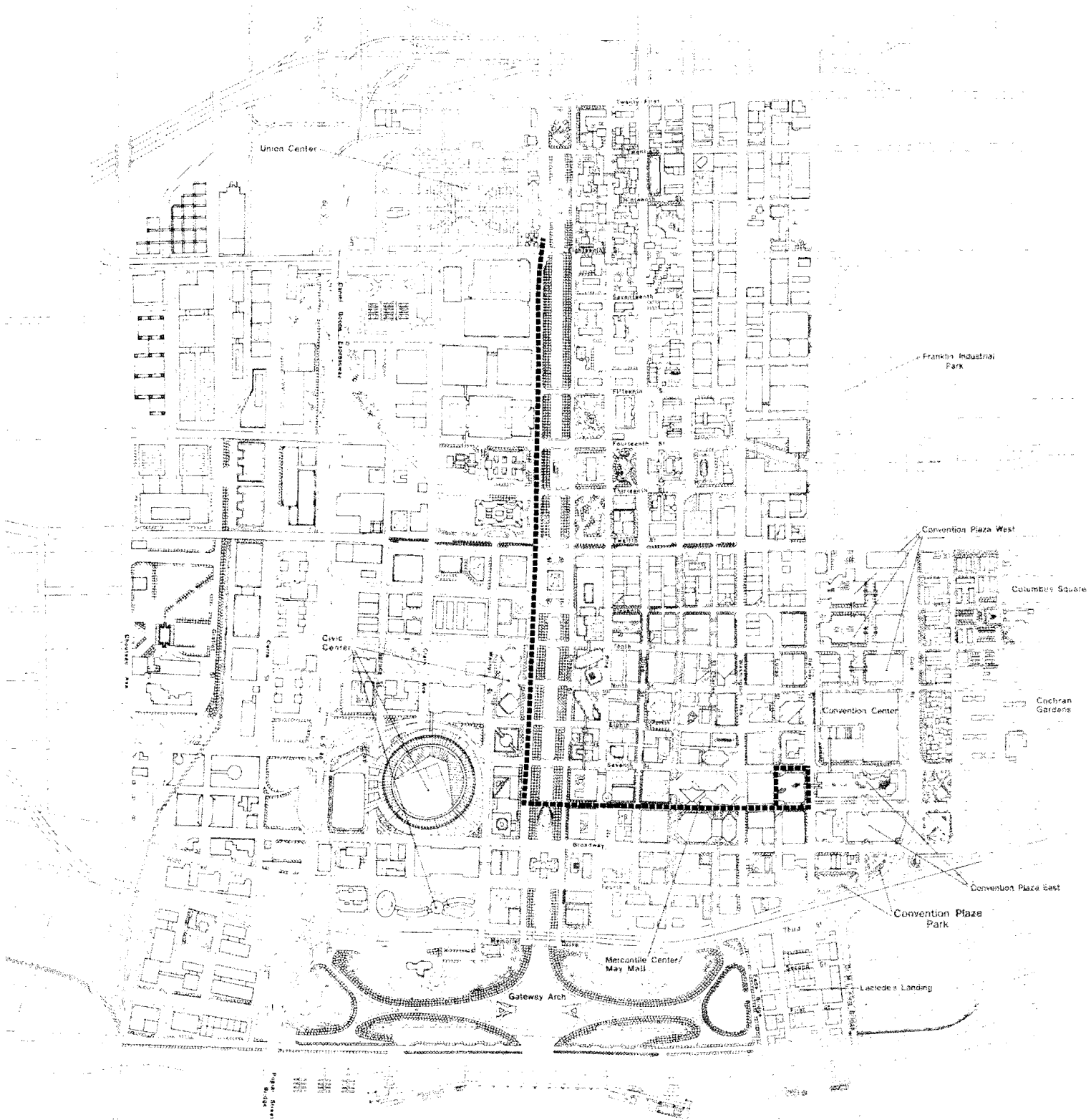


TABLE 10
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION I
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Promotes development south of Walnut Street and along Clark Street West of Tucker Boulevard. ● Connect all new CBD development. ● Could intensify Core development along 4th and 8th Streets.	● Promotes fringe parking on south side. ● Could tie into skywalk system. ● Concentrates existing development patterns. ● Minimal intrusion into Laclede's Landing.	● Compact routing. ● Could be built in stages, loop first then tail. ● Provides north-south Core access. ● Frees tunnel for light rail.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● Mises area west of 8th Street, Loft area, and Convention Plaza West.	● 2 guideways within 4 blocks. ● West leg traverses visually unpleasant area. ● Could conflict with Old Post Office.	● Very poor east-west Core access. ● Potential operational problems with tail and spur. ● No access to Tucker Boulevard activities north of Market.



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Legend

----- Primary Route

ROUTE OPTION J

Figure 14

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri



TABLE 11
ST. LOUIS DPM FEASIBILITY STUDY
ROUTE OPTION J
POTENTIAL ADVANTAGES AND DISADVANTAGES

<u>VALUE CAPTURE</u>	<u>URBAN DESIGN</u>	<u>ENGINEERING</u>
<u>Advantages</u>	<u>Advantages</u>	<u>Advantages</u>
● Connects most activity Centers. ● Would promote development south of Mall. ● Could intensify development along 6th Street.	● Only one Mall crossing. ● Least obtrusive in Core area. ● Could tie into part of skywalk system.	● Short route, cheapest to build. ● Simple operation. ● Access to Core area. ● Frees tunnel for light rail.
<u>Disadvantages</u>	<u>Disadvantages</u>	<u>Disadvantages</u>
● No access to northwest part of CBD, Laclede's Landing or area east of 6th Street. ● Minimum access to hotels east and north of Stadium.	● Run along Mall for 12 blocks. ● Would intensify division of areas north and south of Mall.	● Very poor east-west access in Core. ● No access to Laclede's Landing or Arch. ● Potential problem of double guideway along narrow core street.

Options A through J alternates were presented to the TRC for their comments and responses. The results of those comments included an additional six (6) alternative alignments, for preliminary consideration, these six (6) alternatives are discussed below, and referred to as R-1 through R-6.

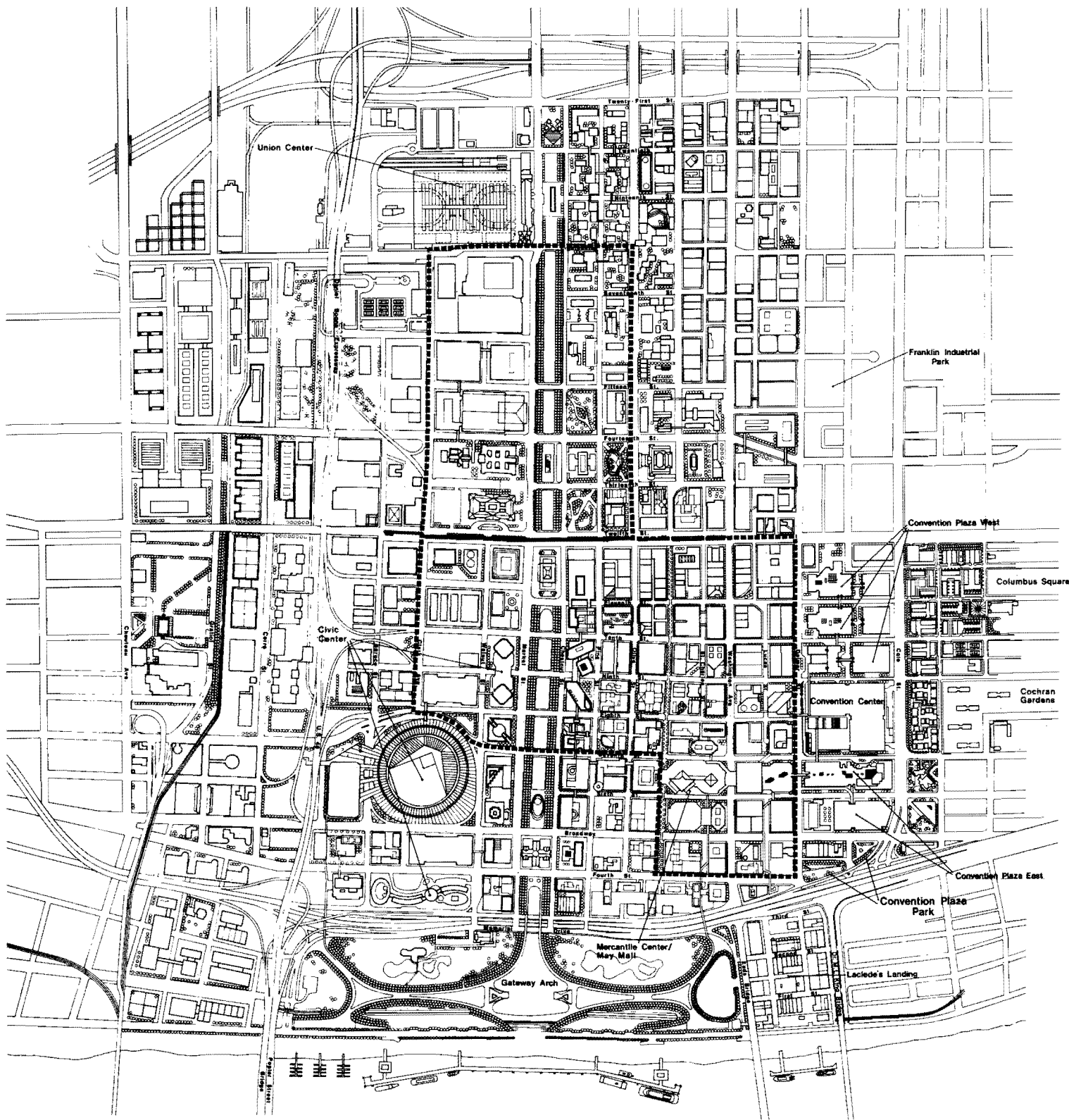
ROUTE OPTION R-1

This option is somewhat similar to Route F in that both are a collapse Route A, (Figure 15). This route is even more collapsed in that it does not go into Laclede's Landing or the Arch grounds. The western two-thirds of this route is identical to Route F. Consequently, it will have some of the same advantages and disadvantages. It does, however, provide much better service to the densest part of the core along Locust and Seventh Streets. This is done at the expense of some service to the hotels north and east of the Stadium, especially Stouffer's Riverfront Towers. It would be difficult to construct a double-guideway along Locust and Seventh Streets due to their narrow width. All the other streets used are wide enough to accommodate the dual guideway.

ROUTE OPTION R-2

Option R-2, shown in Figure 16, is a departure from all the others in that it is oriented north-south instead of east-west. This route also has an optional spur going to Union Station along Clark Street from Eleventh Street. This route has the advantages of securing the densest part of the core, the newly emerging activity areas near the convention center and south of Market Street, west of the Stadium, and Laclede's Landing and part of the Arch grounds.

Because of its length, this route should be a double guideway. This would cause some potential problems on the narrow streets such as Sixth and Ninth Streets. The route does not provide good service to the southeast portion of the downtown which has a large number of hotel rooms. It also provides very poor access to the core west of Tenth Street and north of the Gateway Mall.



Downtown People Mover Feasibility Study

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Figure 15

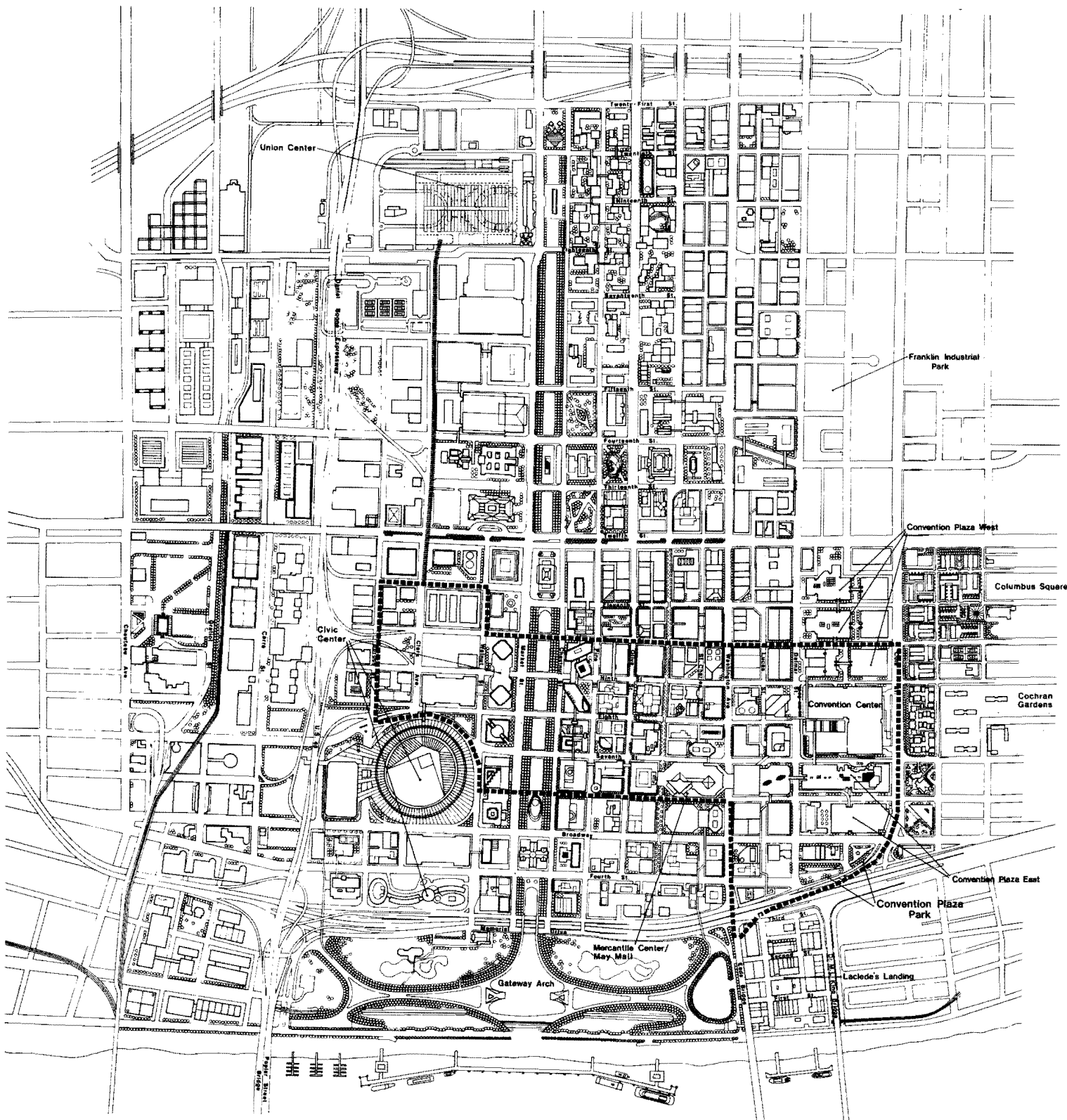
Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

Legend

- Primary Route
- Optional Route

ROUTE OPTION R1





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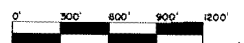
Legend

- Primary Route
- Optional Route

ROUTE OPTION R2

Figure 16

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri



Some engineering problems would be encountered providing access to Laclede's Landing and the Arch grounds. This would require a rather high guideway structure which would have some negative visual impacts on the Landing and Eads Bridge, both of which are National Historic Landmarks.

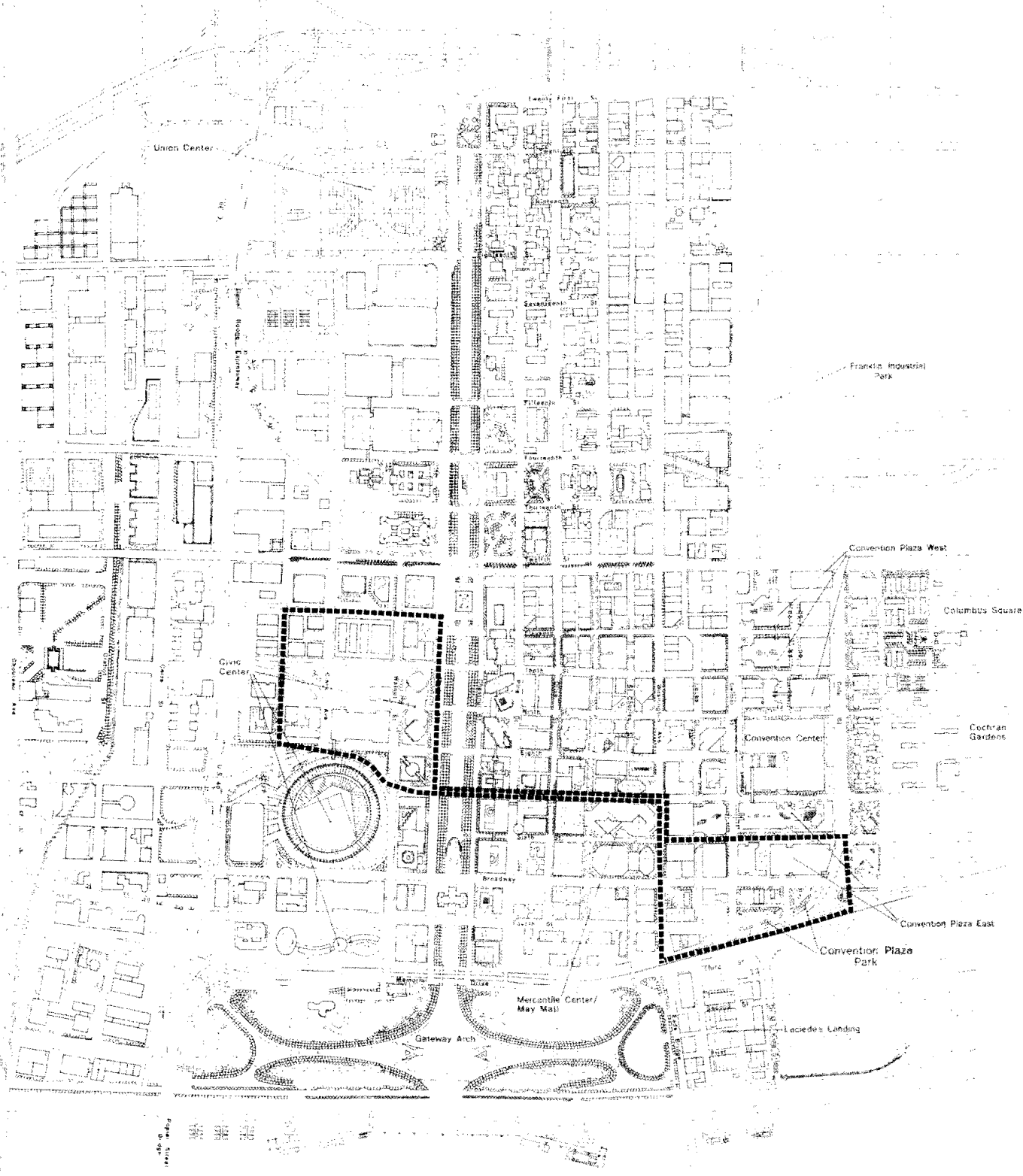
ROUTE OPTION R-3

This route (Figure 17) is similar to Option R-2 except that the two north-south portions have been collapsed and placed on Seventh Street. While this provides excellent access to the central core and the Stadium and Convention Center, it provides no service to any part of the core west of Eighth and north of Market Streets and the area east of Sixth and south of St. Charles Streets. There is also no service to the large number of apartments along and west of Tucker Boulevard.

ROUTE OPTION R-4

Route R-4, shown in Figure 18, is similar in concept to Route Option I in that it is composed of a loop in the core area and a shuttle extending west through the government complex to Union Station. The loop in this route is along Walnut Street, Fourth Street, Washington Avenue, Eighth Street, Convention Plaza, and Tenth Street. This alignment serves practically the entire downtown with the exception of the central and most dense part of the core. There is also marginal service to the Arch grounds, Laclede's Landing and the office activities along Tucker Boulevard. The route does promote development south of the Gateway Mall, in the Convention Plaza-West area, and in the area south of Clark Street west of Tucker Boulevard.

This route could operate as either a one-way or two-way loop with the spur being two-way. A one-way loop, however, could require an unacceptably long time for certain trip desires; however, a two-way loop could pose engineering problems of constructing a double guideway along narrow streets such as Eighth and Tenth Streets.



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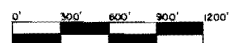
Legend

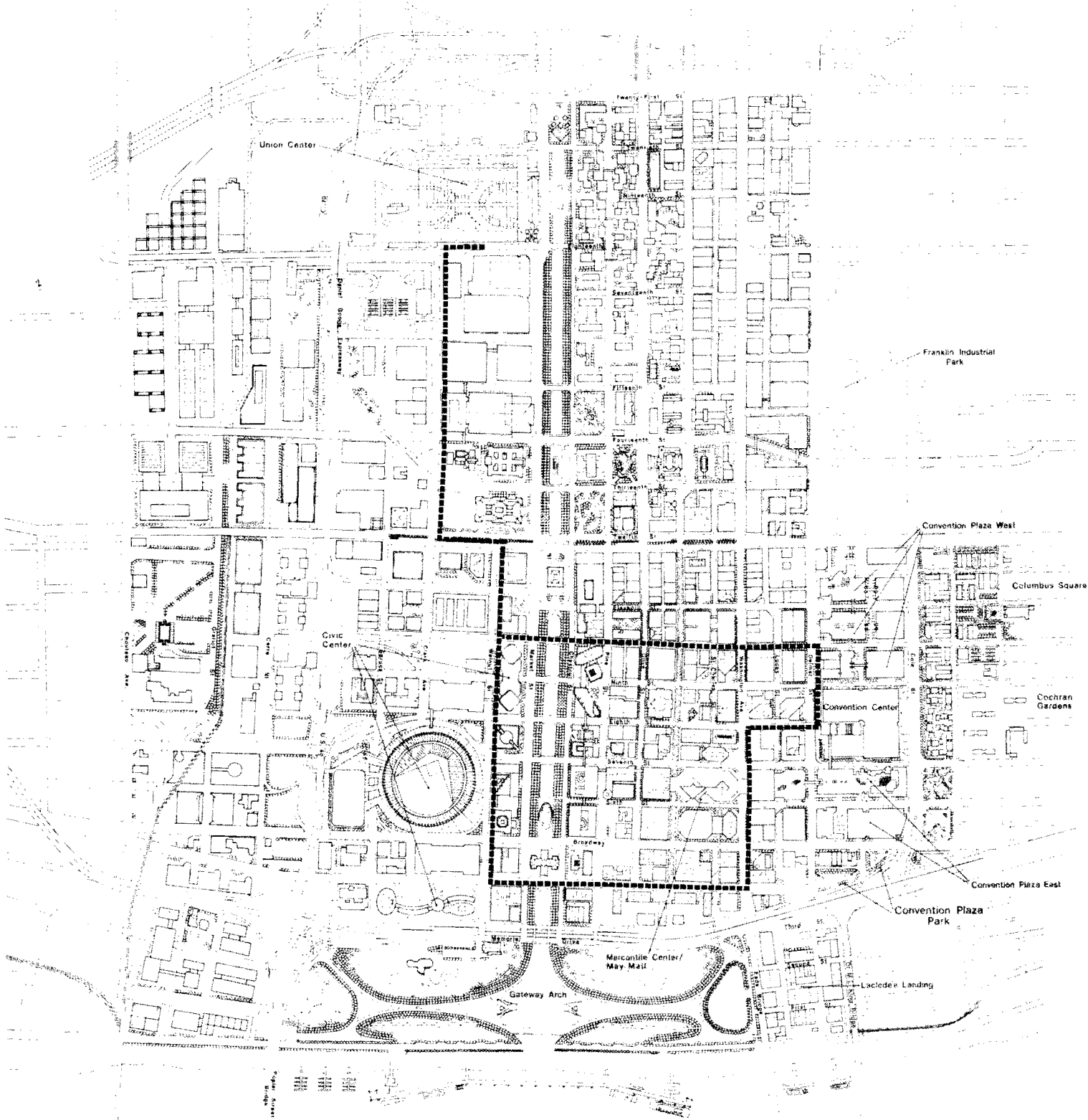
----- Primary Route

ROUTE OPTION R3

Figure 17

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri





Downtown People Mover Feasibility Study

Booker / Bernard Johnson

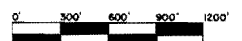
Legend

----- Primary Route

ROUTE OPTION R4

Figure 18

Base Map Courtesy of:
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ROUTE OPTION R-5

Route R-5, shown in Figure 19, is another modification of Option A in that it is basically a large, open loop serving all of the downtown area. This route serves all the downtown activity center, the Arch grounds, and Laclede's Landing. However, it does not adequately serve some of the hotels north and east of the Stadium. The route would intensify development in the core and promote development south of the Gateway Mall and in the Convention Plaza-East area.

Because of its length, the route would be a two-way double guideway. There would be some engineering problems in providing access to Laclede's Landing and the Arch grounds and in integrating the guideway structure into the fabric of the Landing.

ROUTE OPTION R-6

Route R-6, shown in Figure 20, is similar to Route Option R-4 except that it provides an additional spur to Laclede's Landing through the Arch grounds. This spur would create some engineering problems of integration into the Mansion House complex and crossing the Arch grounds. All other aspects of R-4 apply.

DESCRIPTION OF ALTERNATIVE ALIGNMENTS

Deliberation among the TRC members over the sixteen (16) Route Options resulted in the formation of several issues related to satisfying the goals and objectives presented in Chapter II. These issues are as follows:

- The portion of the downtown area east of Tucker Boulevard and west of Memorial Drive is the most important area to be considered in developing alternative alignments. This area should be given a high degree of service with as many of the activities as possible within the walkshed of the DPM alignment.

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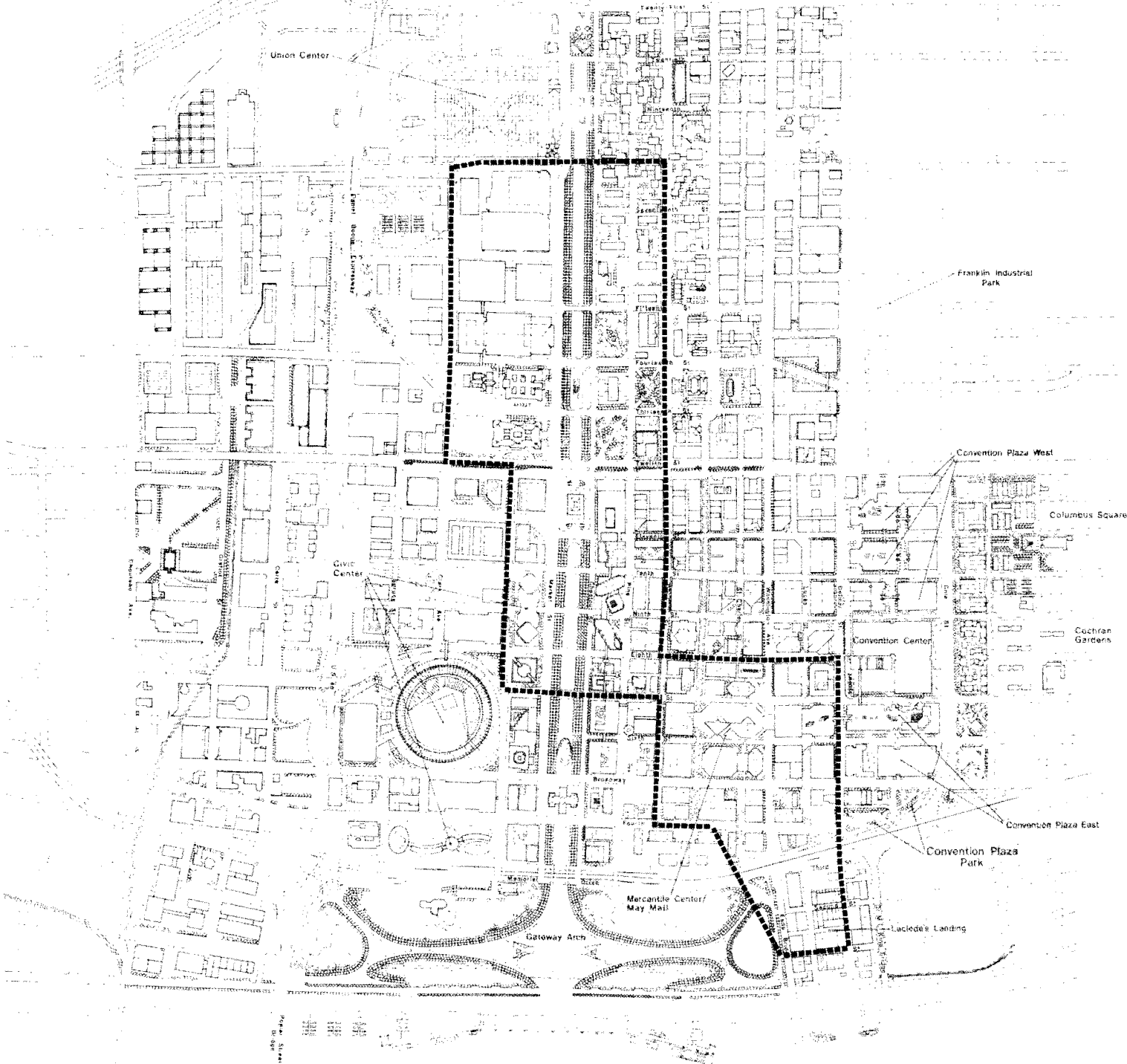
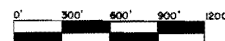
Figure 19

Base Map Courtesy of:
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Legend

----- Primary Route

ROUTE OPTION R5



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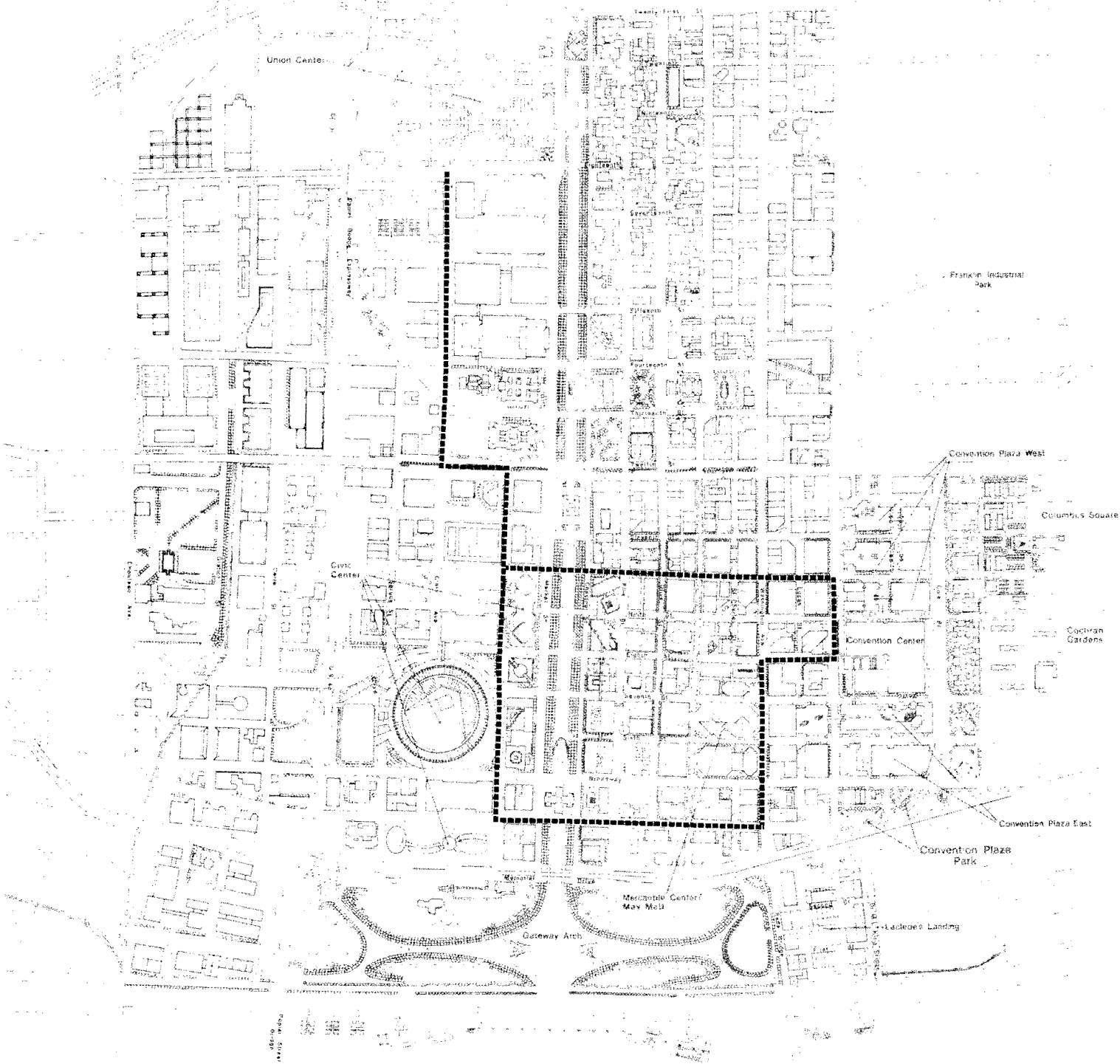
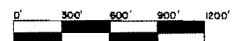
Figure 20

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

Legend

----- Primary Route

ROUTE OPTION R6



- The most important service for the area west of Tucker Boulevard is a connection of the core with both the governmental facilities and the Union Station redevelopment (now named St. Louis Station). This area could be served either along the Gateway Mall or along Clark Street to the south.
- The riverfront area is extremely important in terms of service for the Gateway Arch grounds, the riverboats, and Laclede's Landing. However, at this time, direct access into the Landing would be difficult from both an engineering and cost standpoint.
- The use of the railroad tunnel under Eighth Street and Washington Avenue should be excluded so that the tunnel can be used by a future, regional light-rail mass transit system.
- Coordination with the potential light-rail system and the existing regional bus system must be maximized in evaluating the candidate alignments.
- A balance should be achieved between intensifying the existing core development and promoting new development both in the core itself and in the peripheral areas.

Based on the above and the goals and objectives from Chapter II, the following four (4) alternative alignments evolved.

ALTERNATIVE ALIGNMENT 1

This alignment, shown in Figure 21, is very similar to Route Option R-4. The only exception being the north leg of the loop does not deviate south along Eighth Street to Washington Avenue but stays on Convention Plaza east to Broadway. An optional location of the western spur is shown along Market Street.

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Figure 21

Base Map Courtesy of:
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Legend

○ Station

→ Direction of Travel

----- Primary Route

——— Optional Route

ALTERNATIVE ALIGNMENT 1

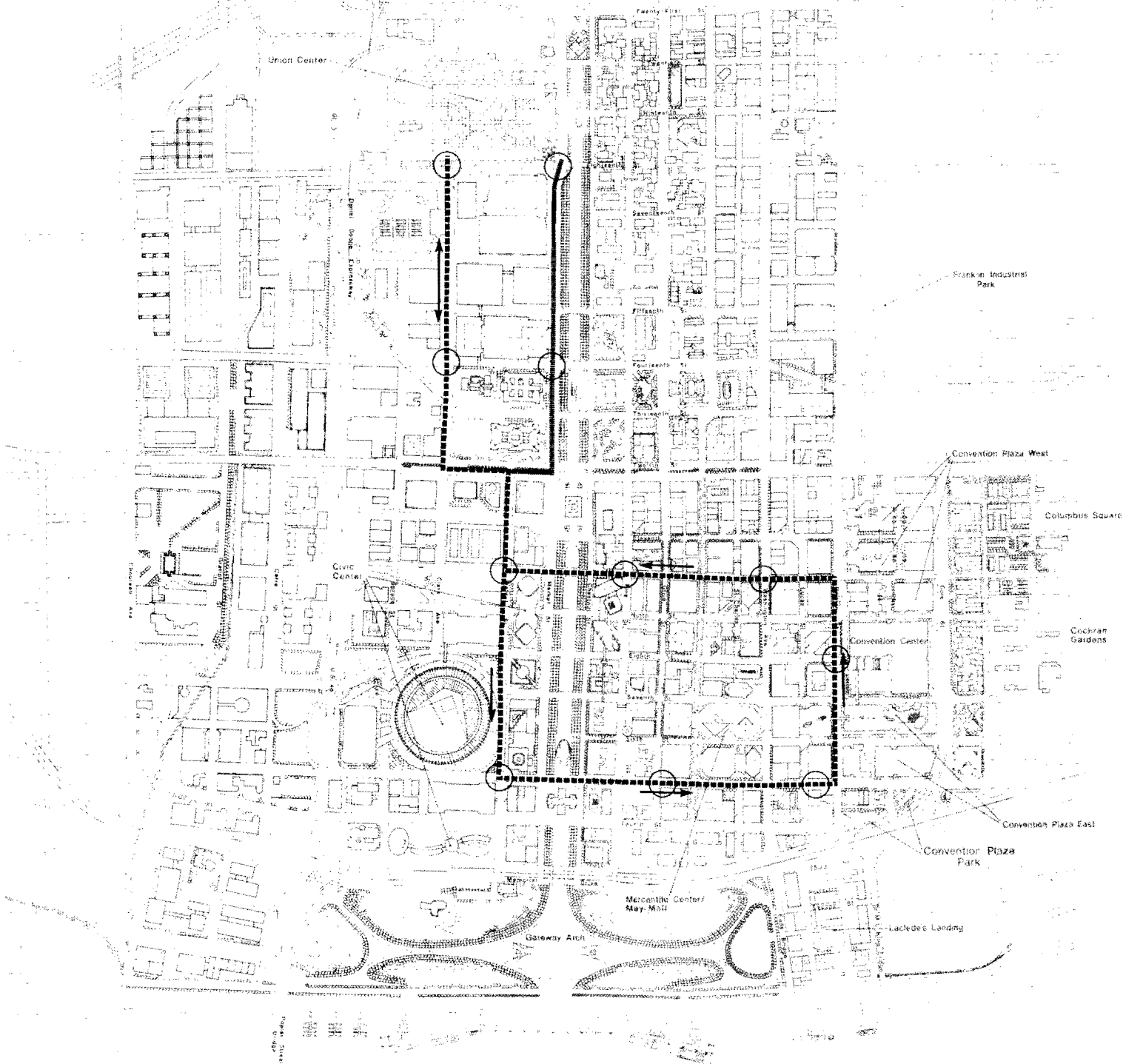
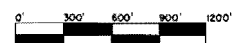


Figure 21 also illustrates the location of the proposed stations for this alignment. The basic criteria for locating the station was that it serve various activity areas and that the station be approximately 1,200 feet apart, if possible. This alignment has a total of nine (9) stations. Along the spur there are two stations; one at St. Louis Station at Eighteenth and Clark Streets and the second at Fourteenth and Clark Streets. This station would serve the city and federal government centers and the users of Kiel Auditorium.

On the one-way loop in the core, there are seven (7) stations. The first is at Tenth and Walnut Streets at the junction point of the spur and loop. This station serves the new IBM/First National Bank complex, the 1010 Market Street office building and KSDK-television offices, and studios and the remodeled Valley Industries building. It would also serve any new development occurring in the existing underdeveloped lots south of Walnut Street.

The second loop station is near the intersection of Broadway and Walnut Street. This station serves the Stadium, two large hotels, several office buildings and the Stadium-East parking garage with approximately 2,700 parking spaces. This station is also the most accessible to the Gateway Arch grounds, two blocks to the east.

The third loop station is on Broadway between Olive and Locust Streets and is the station closest to the retail core and proposed May Mall between Sixth and Seventh Streets. Connection to the May Mall could be made through skywalks. Office activities are present along the east side of Broadway and the Mansion House complex is accessible to the station by new skywalks.

The fourth loop station is located at Broadway and Lucas Street. This location would provide access to the people mover by inter-city bus passengers from the Greyhound and Trailways bus depots and by intraregional bus passengers from Illinois who use Bi-State buses that terminate at Union

Market to the northwest of the station. The station may promote development in the one half block west of the Missouri Athletic Club.

The fifth loop station is located at Eighth Street and Convention Plaza at the entrance to the Convention Center. Obviously, this station would serve the Center and could be connected by skywalk to the Stix, Baer & Fuller parking garage to the southeast. This connection would also permit access to the May Mall development through Stix.

Other connections to the Radisson and Sheraton Hotels would be made through extensions of the existing skywalk system. This station would promote development in the blocks west of Eighth Street and south of Convention Plaza and possibly assist development potential in both Convention Plaza East and Convention Plaza West.

The sixth loop station is located at Tenth Street and Washington Avenue. The station would serve an area in need of revitalization in terms of building rehabilitation, new uses for warehouse and loft-type manufacturing buildings and in fill development of unused and underused parcels. It could provide some access to a portion of the government and office activities along Tucker Boulevard.

The seventh loop station is located at Tenth and Pine Streets and could, possibly, be integrated into the new Southwestern Bell Telephone headquarters facility to be built in the city block to the southeast. This station would also serve some of the governmental activities along Tucker Boulevard as well as the office activities to the east and north.

ALTERNATIVE ALIGNMENT 1A

During the evaluation of the Alternative Alignments, the TRC asked that Alignment 1 be modified by relocating the eastern leg of the loop from Broadway to Fourth Street, one block east. The reason for this was the

desire to improve access to the Gateway Arch, Laclede's Landing, and the riverfront in general (Figure 22).

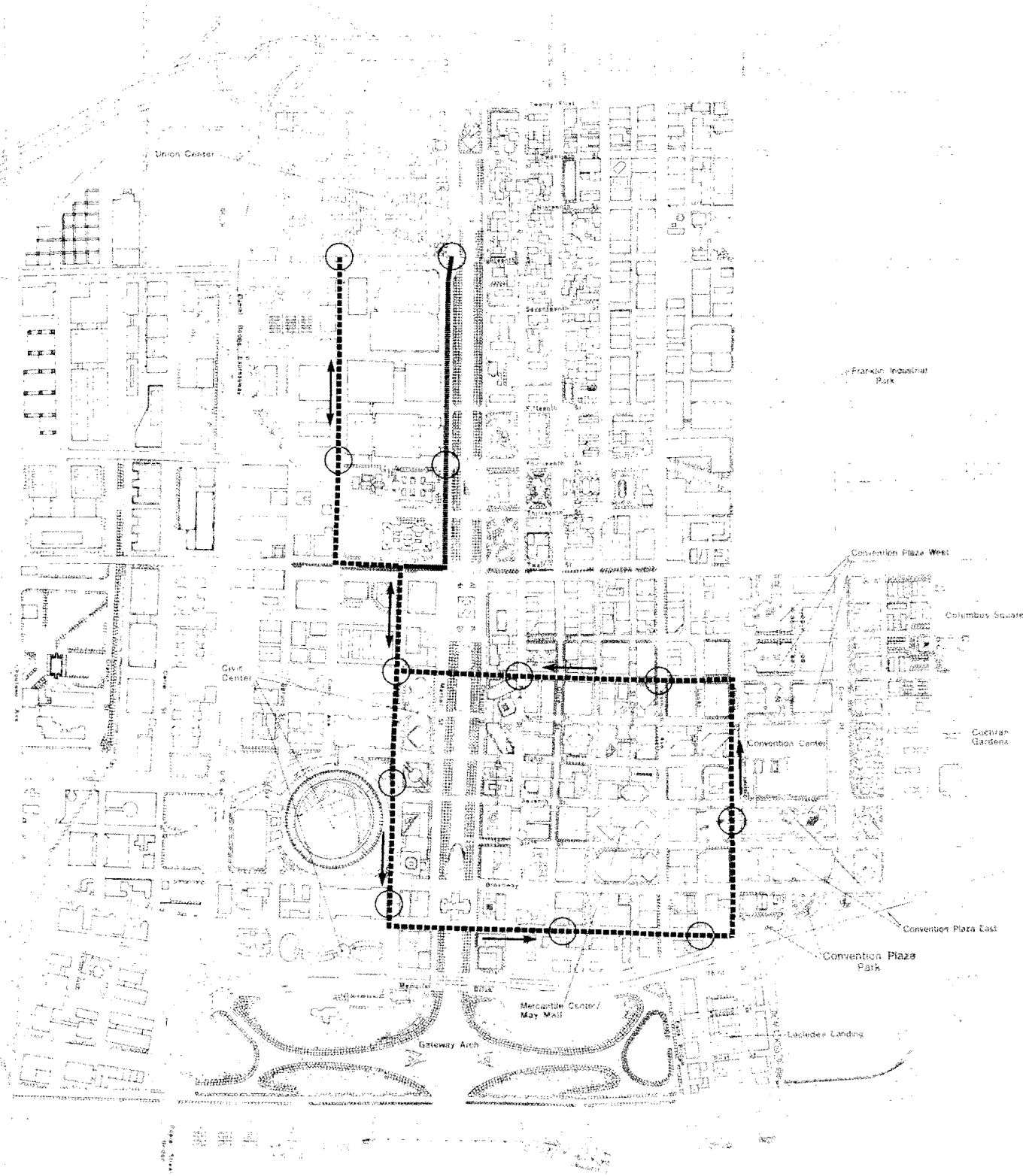
In making this change in the alignment, subsequent changes in the station locations were needed along the loop. Four of the seven stations were relocated and one new station was added. The new station was added at Seventh and Walnut Streets to serve the Stadium, Stadium-West parking garage, the planned National Bowling Hall of Fame, and the Marriott Pavilion hotel.

The original second loop station was moved east one block to Fourth and Walnut Streets. This location places the station within one block of the Gateway Arch grounds and also closer to both Stouffer's Riverfront Towers hotel and the proposed hotel immediately east of the Pierce Building in the northeast corner of Fourth and Chestnut Streets.

The original third loop station was also moved one block east to Fourth Street between Olive and Locust Streets at the Mansion House Center. While this location is close to the Arch and Mansion House, it is farther from the retail core and May Mall and would provide very marginal service access to these areas.

The original fourth loop station was moved one block east to Fourth and Lucas Streets at the Missouri Athletic Club and Bel-Air Hilton hotel. This location provides closer, but not direct, access to Laclede's Landing. Potential patrons must cross Third Street underneath the elevated I-70 viaduct. This location also is further from the core.

The fifth original loop station was also moved one block east to Seventh Street and Convention Plaza to provide better station spacing and better access to the May Mall and Sheraton hotel. This location may also promote development in the Convention Plaza East area, but its relocation would reduce its potential impact on the underused and unused parcels at Eighth Street and on the Convention Plaza West area.



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Figure 22

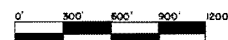
Legend

-  Station
-  Direction of Travel
-  Primary Route
-  Optional Route

ALTERNATIVE ALIGNMENT 1A



Base Map Courtesy of:
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All other stations and their service areas remain the same as Alignment 1.

ALTERNATIVE ALIGNMENT 2

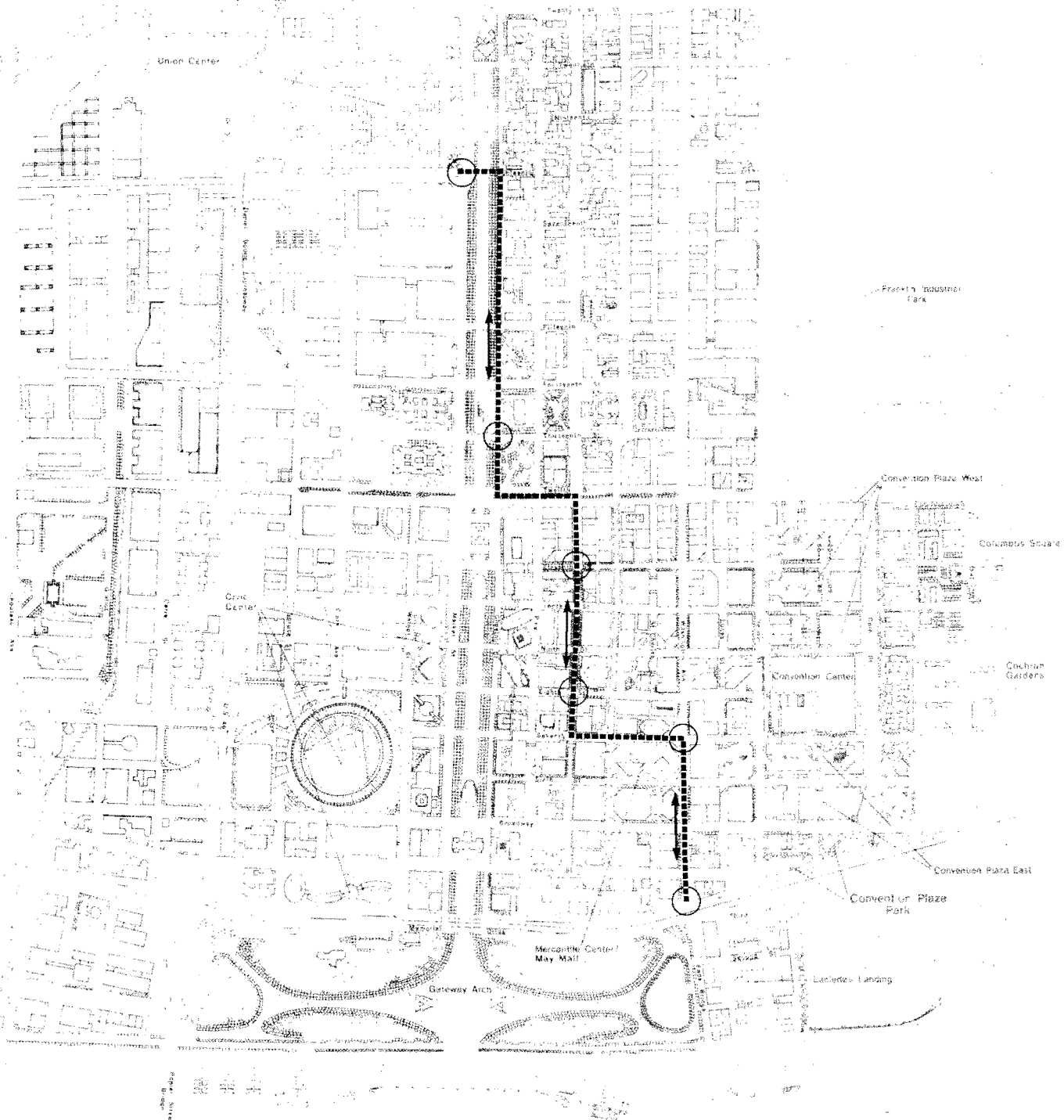
Alignment 2, shown in Figure 23, is the shuttle concept traversing the heart of the downtown core. In that regard, it is somewhat similar to Route Options B and D except that it serves only the core and the St. Louis Station area and not the peripheral areas north or south of the core. The route would operate on a two-way double guideway, which might be split east of Tucker Boulevard due to the narrowness of the streets.

This alignment has a total of six (6) stations which were located using the criteria previously mentioned. The first station is located at Eighteenth and Market Streets at St. Louis Station and would serve that development and, possibly, some of the federal office workers to the east.

The second station is located at Thirteenth and Chestnut Streets and would serve, to some extent, the City government complex south of the Gateway Mall along Market Street and the office buildings to the north.

The third station is located at Eleventh and Olive Streets. This station would serve the office facilities in the area including the governmental activities along Tucker Boulevard and the Southwestern Bell Telephone Headquarters to the south along Pine Street. This station would probably help intensify the development along this portion of Olive Street and help provide a denser link between the core fringe along Tucker Boulevard and the core itself east of Tenth Street.

The fourth station is located at Eighth and Olive Streets, virtually in the heart of the downtown core. This station would serve the rehabilitated Old Post Office and Arcade Building as well as help stabilize some of the older office structures and increase retail potential in this area. The station could also be tied into the potential light-rail system that would use the



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Figure 23

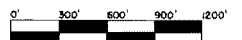
Legend

-  Station
-  Direction of Travel
-  Primary Route

ALTERNATIVE ALIGNMENT 2



Base Map Courtesy of:
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tunnel below Eighth Street. This would provide for an excellent distribution point of interface between the two systems.

The fifth station is located at Seventh Street and Washington Avenue at the northwest corner of the May Mall. In all likelihood, the station would be integrated into the Mall structure or the Stix, Baer & Fuller department store to the north. The station would have positive impacts on possible re-use of the city block to the northwest and would be accessible to the Convention Center through skywalks and the Stix store.

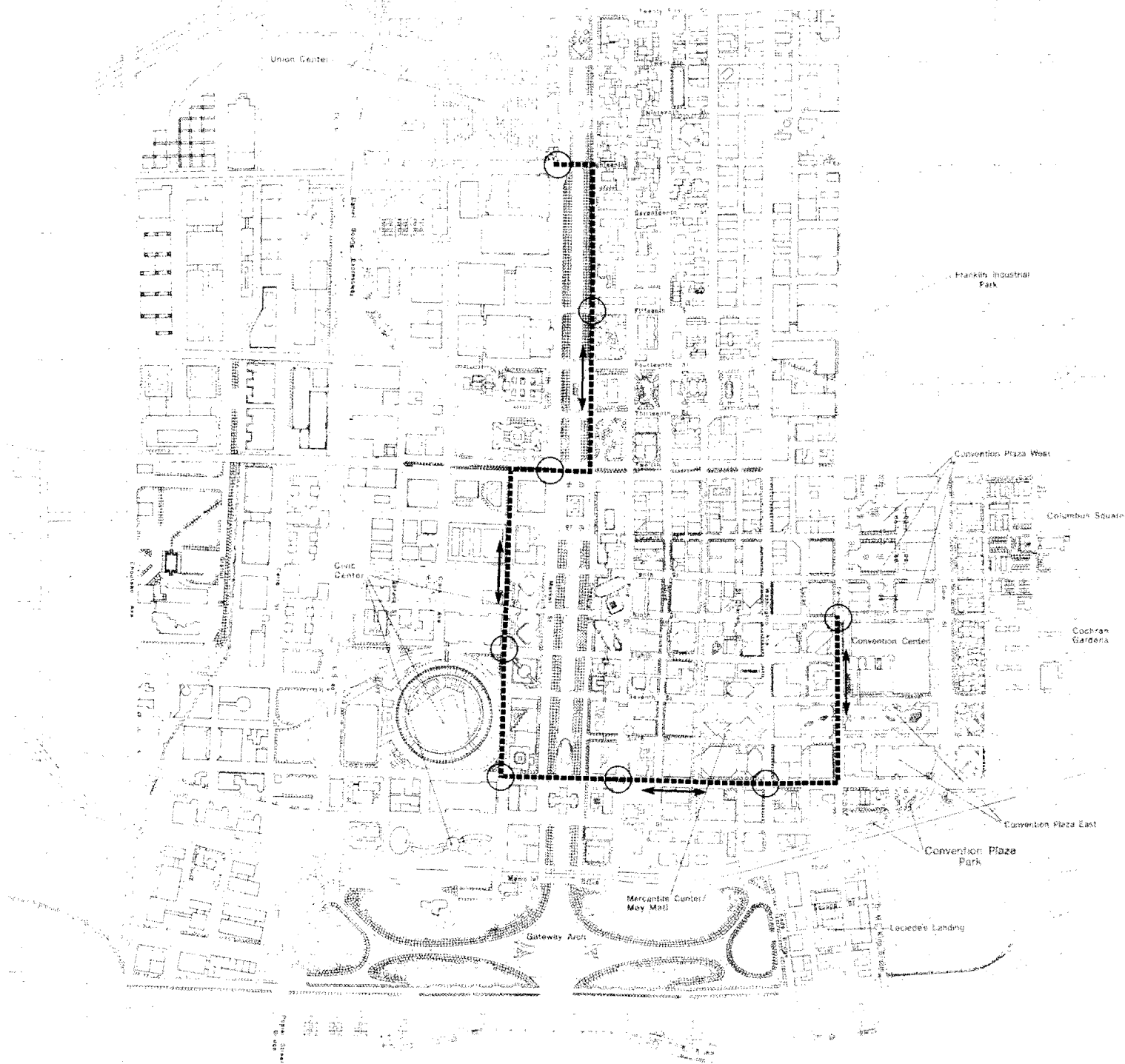
The sixth station is located at Third Street and Washington Avenue. This location would provide service to Laclede's Landing, possibly through a skywalk over the I-70 viaduct to the upper level of a structure in the Landing or via an improved walkway under I-70. Also accessible from this station is the Mansion House Complex, the Bel-Air Hilton hotel, and the Missouri Athletic Club.

ALTERNATIVE ALIGNMENT 3

Alignment 3, shown in Figure 24, is similar in concept (two-way shuttle) to Alignment 2 and Route Option J. In effect, it is a perimeter shuttle route that does not serve the densest part of the downtown core, but provides service to peripheral activities and the trips taken between them.

The route has eight (8) station locations. The first is at St. Louis Station and serves that area. The second is located at Fifteenth and Chestnut Streets and serves the Plaza Square Apartments and, to some extent, the government offices and Kiel Auditorium south of the Gateway Mall. There is also marginal service to some of the offices to the north.

The third station is located at Tucker Boulevard and Market Street and serves the City and federal government offices at this location. It will marginally serve the other office activities north along Tucker Boulevard and to the east. It may marginally promote development to the east and south.



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Figure 24

Legend

○ Station

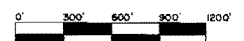
→ Direction of Travel

----- Primary Route

ALTERNATIVE ALIGNMENT 3



Base Map Courtesy of:
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The fourth station is located at Eighth and Walnut Streets and will serve those activities indicated for the new station of Alternative 1A. The fifth station located at Broadway and Walnut Streets serves the same activities and areas as the fourth station of Alignment 1.

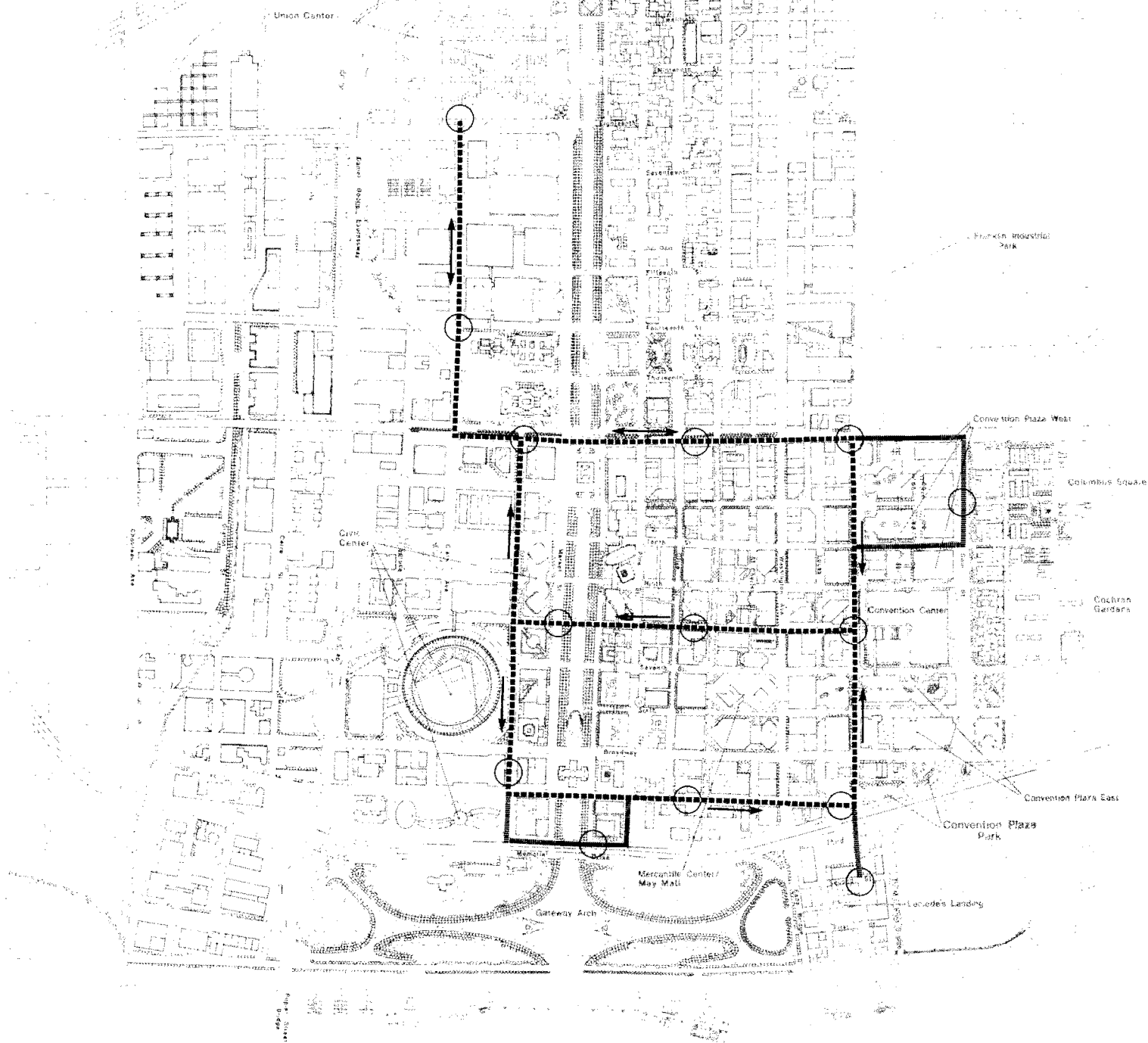
The sixth station is located at Broadway and Pine Streets and would serve the Boatman's Tower, a new office structure proposed in the northwest corner of this intersection, and the Stadium North "B" Garage in the southwest corner of the intersection. The station would have a positive impact on the half block vacant lot to the northeast. It is not located well to serve the retail core, but would be linked by existing skywalks through three parking garages to the Famous-Barr department store, and, subsequently, the retail core and May Mall.

The seventh station is located at Broadway and Washington Avenue and would be tied directly into a new office and/or hotel built as a part of the May Mall to the southwest. It could also serve the 500 Broadway Building and have a positive impact on the vacant lot west of the Missouri Athletic Club and could marginally serve the Trailways bus station and Union Market intra-regional bus station.

The eighth station is located at Ninth Street and Convention Plaza. It would serve the Convention Center and Radisson Hotel directly and, through skywalks, Convention Plaza West and East and the Sheraton hotel, the Stix garage, and May Mall. It would have a positive impact on the underused parcels south of Convention Plaza.

ALTERNATIVE ALIGNMENT 4

Alignment 4 is a figure "8" with a spur shuttle to St. Louis Station and the government complex (Figure 25). The loop portion of the alignment uses Tucker Boulevard, Convention Plaza, Fourth Street, and Walnut Street with a north-south connection in the center along Eighth Street. In terms of



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Figure 25

Legend

○ Station

→ Direction of Travel

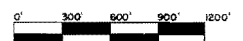
----- Primary Route

———— Optional Route

ALTERNATIVE ALIGNMENT 4



Base Map Courtesy of:
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J

operation, this alignment could provide up to three (3) possible routes: one going counter-clockwise along the eastern rectangular segment; a second going clock-wise along the western rectangular segment; and the third route traversing the entire figure "8". Operation along the spur would be less frequent than that on the two loops and a fixed frequency, say every third train, could operate along this spur. Because of this operation, there would be a single guideway for the loops with a double guideway for the spur to St. Louis Station.

The alignment has a total of eleven (11) stations; two on the spur and nine on the two loops. The two stations on the spur are located at the same sites as those in Alignment 1 and would serve the same activities and areas. Likewise, the station along the eastern portion of the loop (guideway along Fourth Street) are at the same sites as those in Alignment 1A.

The third station is located at Tucker Boulevard and Walnut Street and serves City Hall, Federal Courts, Civil Courts and other office activities to the east. This station location would also promote development south of Walnut Street as well as serve the new development under construction in the blocks between Market and Walnut Streets east of Eleventh Street.

The fourth station is located on Tucker Boulevard between Olive and Locust Streets. This station would serve the government and other office activities along Tucker Boulevard and to the east and west. It will also serve the Jefferson Arms apartments and would promote the development of empty parcels in this area and assist in the rehabilitation of such structures and the Shell and Silk Exchange buildings.

The fifth station is located at Tucker Boulevard and Convention Plaza. This station serves the office facilities both east and west of Tucker Boulevard; the two daily newspapers; and, at least marginally, the new industrial activities taking place in Franklin Industrial Park to the northwest. The stations would have positive development impacts on Convention Plaza West and, possibly on the Loft District to the southwest along Washington Avenue.

The sixth station is located at Eighth Street and Convention Plaza and is at a transfer/interchange point between the east and west loops. This station serves the same areas and would have the impacts on the surrounding property as the seventh station of Alignment 1.

The seventh station is located on Eighth Street between Olive and Locust Street at the Old Post Office. It would serve the same area and have the same impacts on the surrounding property as the fourth station of Alignment 2. This station would also be connected with the regional light-rail system that would utilize the tunnel under Eighth Street making this point the major access and distribution location on both systems.

The eighth station is located at Eighth and Market Streets and would basically serve the same areas and have the same impacts as the fourth station of Alignment 3.

ALTERNATIVE ALIGNMENT 4A

As part of the evaluation of the Alternative Alignments, the TRC requested that three (3) options be examined as part of Alignment 4. The individual options are explained in the following paragraphs and also shown in Figure 25. For report purposes, Alignment 4 with these options will be titled Alternative Alignment 4A.

Alignment Options - Columbus Square

This option extends the western loop to the north along Tucker Boulevard then east and south along Cole and Tenth Streets, respectively, to the original route. The purpose of this extension is to serve the Columbus Square housing development of over 500 units of mixed income levels. The option would add one station to the alignment at the intersection of Eleventh and Cole Streets. The station would serve both Columbus Square and the parking

garages planned along the south side of Cole Street as part of Convention Plaza West.

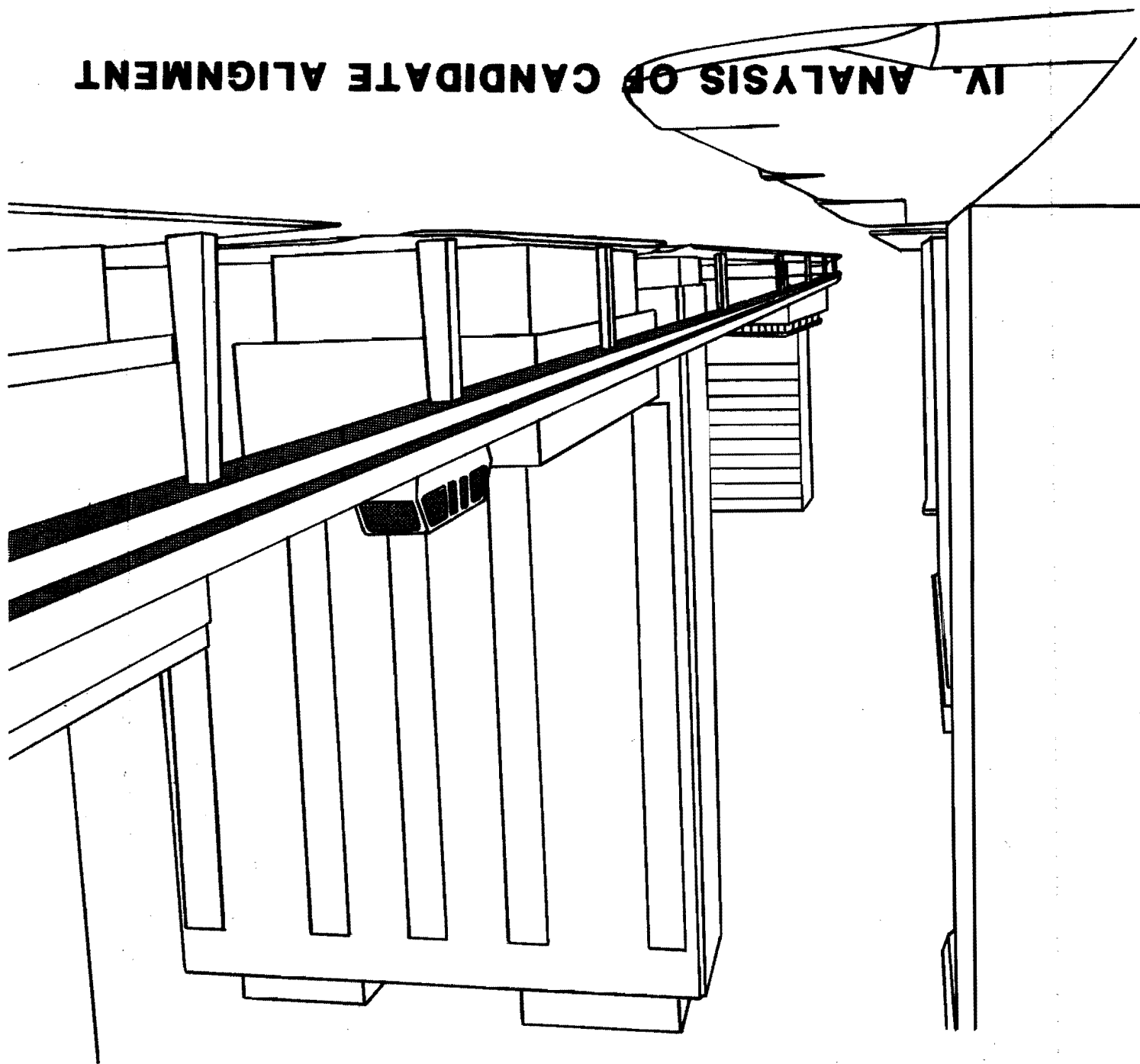
Alignment Option - Laclede's Landing

This option would provide direct access into Laclede's Landing through an extension of the guideway to the east from the corner of Fourth Street and Convention Plaza. The extension would be elevated over I-70 and would end in an upper level of a building in the Landing, possibly a fourth to sixth floor "sky lobby" of a new hotel. Operationally, the extension could be a single guideway with the vehicle changing direction or "backing-up," after making the stop at the station. The vehicle would then traverse the route by running "backwards."

Alignment Option - Gateway Arch

This option is also an extension of the eastern loop east along Walnut Street to north along the west side of Memorial Drive, and west along Pine Street to the original route. The extension would bring the alignment to the western edge of the Arch grounds and provide much better access to that area and the riverfront in general. This extension also provides an extra station located at Chestnut Street and Memorial Drive. This station could possibly be integrated into the design of a new hotel planned for the parking lot to the northwest of the intersection. The extension would also reduce the visual conflict of the Fourth Street guideway location because Memorial Drive is lower in elevation than Fourth Street in this area.

IV. ANALYSIS OF CANDIDATE ALIGNMENT



IV. ANALYSIS OF CANDIDATE ALIGNMENTS

ENGINEERING, GUIDEWAY, AND SYSTEMS

The discussion of DPM engineering, guideways, and systems will begin with an overview of available and operating systems, and conclude with a breakdown of costs and system components by alternative alignments. This section will include discussions of vehicle suppliers and characteristics, guideway types, guideway characteristics, basic stations, support facilities and construction, operation, and maintenance costs.

VEHICLE SUPPLIERS AND CHARACTERISTICS

Eight potential vehicle suppliers for the St. Louis Downtown People Mover (DPM) are Boeing, Vought, MATRA, OTIS, Universal Mobility, Urban Transportation Development Corporation, Disney, and Westinghouse. These eight suppliers have vehicles that meet the requirements of a DPM system established by UMTA. Several other vehicle manufacturers, such as the Ford Act and the Disney Monorail Systems, have been tested and are now in service at several locations in the United States. However, these firms are no longer active in the competitive market for the AGT vehicle systems. Therefore, even though these vehicle systems do exist and may still be available they have not been considered as eligible suppliers for the DPM system.

The main difference between an AGT system and other mass transit systems is the use of a fully automated computer control vehicle confined to an exclusive right-of-way. Although all of the eligible DPM vehicle suppliers have computer control vehicles, there is a wide range in the command and control systems (C & CS). The C and CS range from a simple train emergency stop control to complex train speed control and networking control systems.

Figure 26 shows some of the basic characteristics of seven potential vehicle suppliers. They include the basic physical and operational characteristics

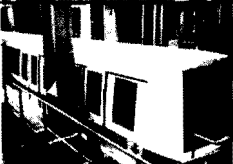
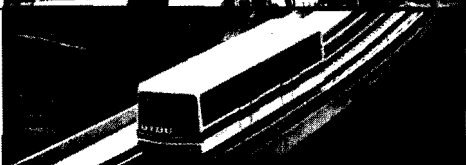
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POTENTIAL VEHICLE SUPPLIERS

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Figure 26

		VEHICLE CAPACITY PERSONS PER VEHICLE	TRAINING CAPACITY	STATION LENGTH (FEET)	MINIMUM HEADWAY (SECOND)	CRUISE VELOCITY (MPH)	MAXIMUM GRADE (%)	MINIMUM HORIZ. CURVE (FEET)	MINIMUM CURVE AT CRUISE VELOCITY (FEET)	CAPITAL COST PER VEHICLE	ANNUAL O & M COST PER VEHICLE
BOEING		23	NONE	30'	NA	30	10	30	300	\$425,000	\$55,400
VOUGHT		60	2-CAR TRAIN	60'	18	35	8	90	410	\$524,000	\$79,700
MATRA		100	2-CAR TRAIN	80'	60	37	10	130	460	\$700,000	NA
OTIS		22	3-CAR TRAIN	60'	2	25	6	50	210	NA	NA
UNIVERSAL MOBILITY		20	5-CAR TRAIN	80'	45	15	8	50	75	\$103,000	\$7,000
WESTINGHOUSE		100	2-CAR TRAIN	80'	70	40	10	100	535	\$700,000	\$75,100
UTDC - ICTS		70	2-CAR TRAIN	80'	47	43	8	65	670	\$600,000	NA

of each vehicle. Figure 26 also shows the capital costs of these each system, which includes a vehicle cost and command and control system cost. Where available, operations and maintenance costs for systems which have been in continuous use are also shown.

The ten basic vehicle characteristics shown in Figure 26 are:

- Vehicle capacity
- Training capacity
- Station length
- Minimum headway
- Cruise velocity
- Maximum grade
- Minimum horizontal curve
- Minimum curve at cruise velocity
- Capital cost
- O&M costs

Vehicle Capacity

The vehicle capacity, maximum number of passengers per vehicle, is important in determining the number of vehicles required for a given route. The vehicle capacity is dependent on the ratio of standing to seated passengers. By increasing this ratio the capacity of the vehicle will increase. An average value for vehicle capacity is shown in Figure 26. Each of the seven vehicles has been classified either as a small, medium or large vehicle based on the vehicle capacity. Of the seven vehicle systems studied for the St. Louis DPM there are three small vehicles, two medium vehicles and two large vehicles.

Training Capacity, Station Length, and Minimum Headway

All of the eligible vehicle systems, except Boeing, are capable of coupling two or more individual vehicles into multi-vehicle trains. This training

capability is important during the periods of peak demand where minimum headways may be critical. By coupling vehicles together to form a train the capacity of this system increases without having to reduce headways between vehicles. Boeing uses shorter headways to increase system capacity.

The training capability of the vehicle also has an influence on the size of each station along the route. Each station must be designed to accommodate both a minimum and maximum size train that will be used in the systems. Smaller stations are advantageous in an urban environment where there is limited space available. Station costs are influenced by the size, both in construction costs and right-of-way acquisition.

Cruise Velocity

The cruise velocity of the seven vehicle systems varies from a minimum of 15 mph to a maximum of 45 mph. Cruise velocity, after the vehicle capacity, has the next largest influence on the number of vehicles required for a route. Since the vehicle with the higher cruise velocities are capable of meeting higher peak demands, fewer vehicles would be required. Vehicles with cruise velocities in excess of 45-50 mph, however, would have no added benefit due to the short spacing between stations in the St. Louis DPM scenario. Vehicles with the higher velocities would be unable to reach their maximum speed between stations due to the time required for acceleration and deceleration.

Minimum Horizontal Curves and Minimum Curve at Cruise Velocity

The minimum horizontal curves shown in Figure 26 are based on the size of the vehicle and their interface with the guideway structure. The minimum curve radius of the guideway is important in an urban environment due to the narrow street widths and congested areas. Though the vehicle is capable of negotiating the short radius curves, their velocity must be reduced to meet the ride comfort criteria.

Figure 26 also shows the minimum horizontal curve radius for each of the seven vehicles based on the cruise velocity of each vehicle. The minimum radius of curvature at cruise velocity assumes a 10 percent superelevation of the guideway along with a maximum lateral acceleration of 10 percent.

The minimum radius is computed from the following equation:

$$R = \frac{V^2}{(.1 + .1)(g)}$$

where: R = radius of curvature
V = vehicle velocity (ft/sec)
g = acceleration due to gravity - 3.2 1/sec²

The factors of 0.1 represent a 10 percent superelevation and 10 percent times gravity unbalanced lateral acceleration in a curve.

Capital Costs, O&M Costs

The capital costs shown in Figure 26 include the cost of the basic vehicle including the prorated share of the command and control system. The operations and maintenance costs for various systems are from the Summary of Capital and Operations and Maintenance Cost Experience of Automated Guideway Transit Systems Costs and Trends for the Period 1976-1978. The costs have been escalated to 1980 dollars. The O&M costs are based on a cost per vehicle. These costs include labor, materials and utilities for maintaining and operating the system. O&M costs for the small and medium vehicles may be significantly higher than the large vehicle due to the higher number of vehicles required.

The Boeing vehicle is classified as a small vehicle with a capability of 23 passengers per vehicle. The Boeing system is the only system that has been demonstrated in an urban environment. The Boeing system has been operating

in Morgantown, West Virginia since 1975. Phase I was completed in 1975 and after a 2-year shutdown the system was reopened with Phase II completed in 1979.

The Vought system has been in operation at the Dallas/Fort Worth International Airport since 1975. The 13 mile system of elevated and at-grade guideway is capable of carrying both passengers and baggage. This system is highly adaptable to an urban environment. The AIRTRANS system operates seven days a week, with a reliability in excess of 99 percent.

The MATRA VAL system was demonstrated at a test track facility in France in 1973. Design and construction of a DPM system for the city of Lille, France, is under way. A fully operational system has not been demonstrated, therefore, operations and maintenance costs for the MATRA system are unavailable.

The OTIS Elevator Transportation Technology Division is the vehicle supplier for the Duke University automated guideway system. The guideway was constructed to join the existing hospital facilities with the newer constructed hospital building. The guideway is capable of carrying both passengers and hospital supplies. The OTIS vehicle is the only system that has an air cushion support system. Lack of operation experience precludes the availability of O&M data.

Universal Mobility has the most operational systems of the vehicle suppliers. They operate systems at 15 parks and amusement areas around the United States. Because of the low speeds of the UMI vehicle (8 mph cruise velocity) the vehicles have been developed with no suspension system required. This system may have to be substantially upgraded to be used in the DPM system. The O&M costs from the N.D. Lea and Associates assessment report shown in Figure 26 for the UMI system is based on a limited yearly service. The O&M costs are for the Kings Dominion Amusement Park, which operates a maximum of 10 hours a day, 6-1/2 months per year.

The first operating system for the Westinghouse vehicle was placed in service in 1971 at the Tampa International Airport. Other installations include the Sea-Tac International Airport, Miami International Airport and the Busch Gardens Amusement Park. The Westinghouse systems have been demonstrated to be highly efficient and easily adaptable to a DPM installation with operational availability in excess of 99 percent.

The Intermediate Capacity Transportation System developed by the Urban Transportation Development Corporation (UTDC) has just completed testing under UMTA observation and complies with requirements of DPM systems. Further testing is under way at the UTDC test track in Kingston, Ontario, Canada. Unlike most other vehicles, the UTDC system uses steel wheels and rails for its support and guidance system and a linear induction motor for propulsion. A continuously welded rail is mounted directly to the upper guideway surface. The supplier claims excellent operational characteristics in snow and ice environments.

Community Transit system, a division of Walt Disney Productions, offers the WEDWAY as a people move system. Demonstrated at Walt Disney World and Disneyland, the system uses a special steel trackwork on top of conventional beams, such as a double-tee guideway. The six passenger cars are driven at low speed by linear induction motors. The first commercial installation is under construction at Houston Intercontinental Airport.

GUIDEWAY TYPES

The number of guideway types which might be used in St. Louis is limited only to the designer's imagination. As a practical matter, however, there are eight general types of guideway which are considered to be the most probable candidates for use in the downtown St. Louis area. These eight types, Figure 27, represent actual structures which have been proposed or installed in DPM-type applications around North America. They are:

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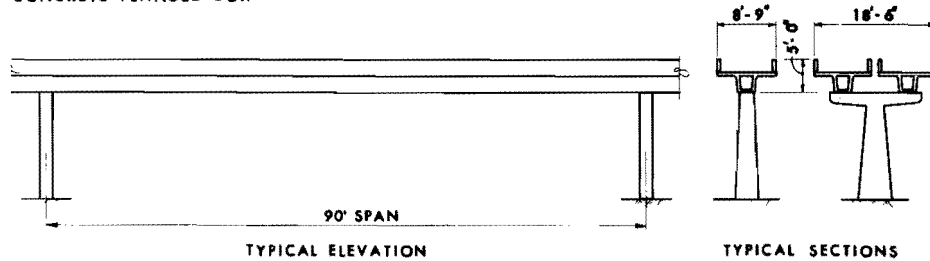
GUIDEWAY TYPES

Booker/Bernard Johnson

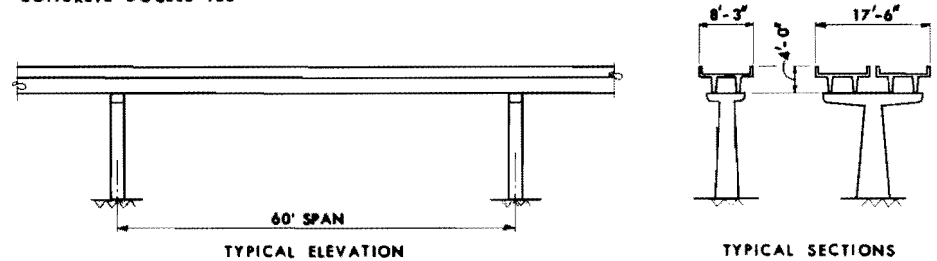
ASAM
CONSULTING ENGINEERS
400 SOUTH 10TH STREET, ST. LOUIS, MO 63103
(314) 241-1100

Figure 27

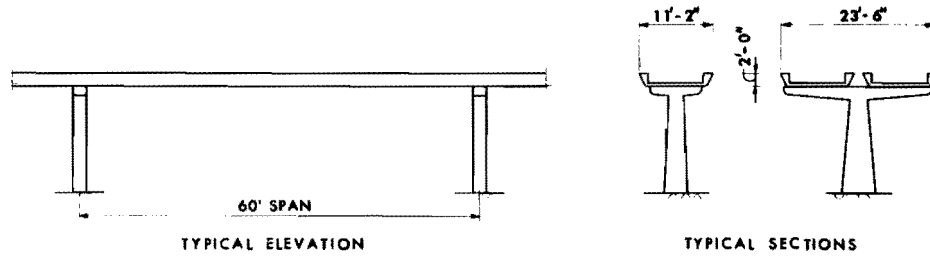
CONCRETE FLANGED BOX



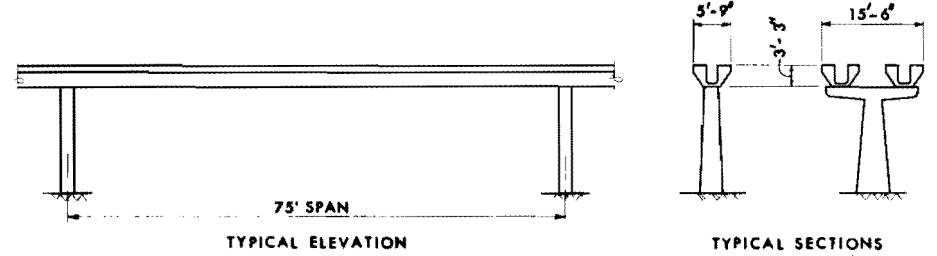
CONCRETE DOUBLE TEE



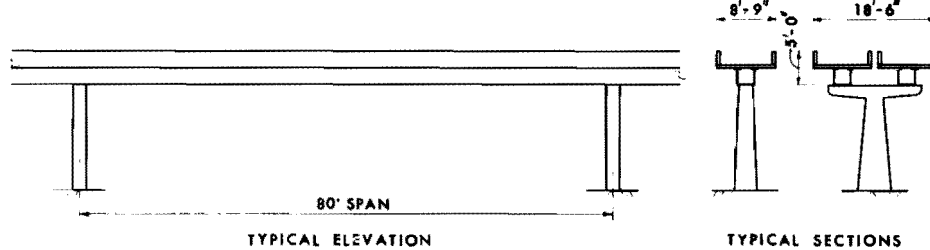
CONCRETE CHANNEL



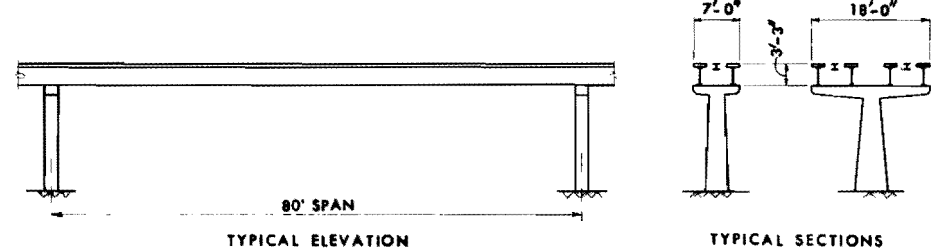
NARROW CHANNEL



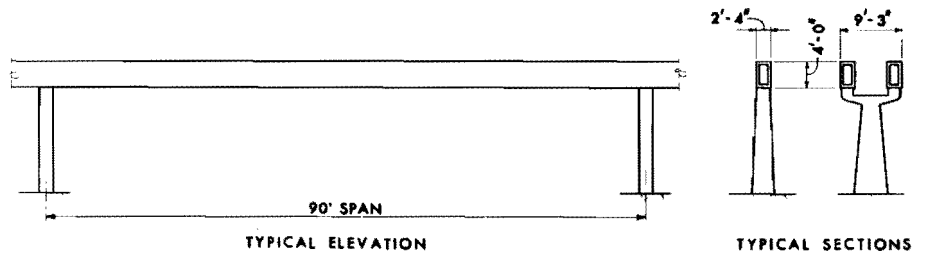
COMPOSITE FLANGED BOX



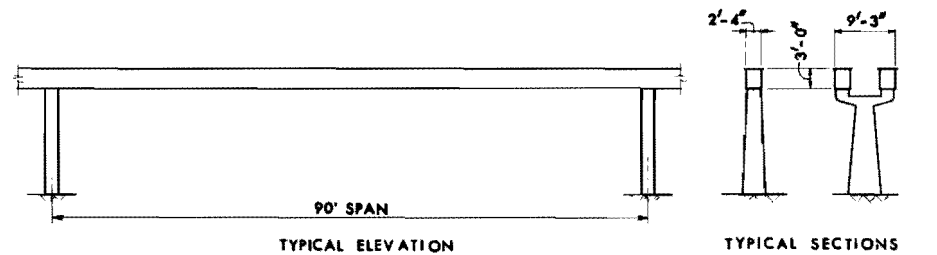
DOUBLE PLATE GIRDER



CONCRETE BOX



STEEL BOX



- Concrete flanged box
- Concrete double tee
- Concrete channel
- Narrow concrete channel
- Composite steel flanged box
- Double plate girder
- Concrete box
- Steel box

Concrete Flanged Box

The concrete flanged box consists of a concrete box girder with an extended flange on the top side. The box provides torsion resistance and the top flange helps provide long-span capacity. Sidewalls may be added for vehicle retention, steering or noise suppression. This type of guideway was used at Dallas/Fort Worth International Airport.

Concrete Double Tee

The concrete double tee attempts to use standard industry precast concrete elements. Double tee beams are frequently found in building and parking garage structures. Small modifications to these standard beam shapes make them acceptable for guideway use. Ease of manufacture make them an extremely economical solution. The double tee is usually accompanied by a cast-in-place concrete topping and may include sidewalls similar to the concrete flanged box. Double tee beams were used at the Metropolitan Toronto Zoo.

Concrete Channel

The concrete channel is an integrated structure where the sidewalls also form the top section of the beam. Thus, the channel provides the thinnest cross section for a guideway. This particular shape has received widespread recognition as an excellent solution where side views and minimization of side height of the guideway is a desired characteristic. The vehicle rides on the bottom of the channel between the sidewalls. The channel guideway has been used at Fairlane Town Center in Dearborn, Michigan, and at the Hartford Airport in Connecticut.

Narrow Channel

The narrow channel is a variation of the concrete channel described above. In this instance the two sidewalls of the beam are brought closer together and the vehicle is placed on top of the beam. For this system to work, the vehicle steering mechanism must be depressed into the slot between the channel legs. This concept has not been used in practice but has been suggested for Westinghouse applications at various sites.

Composite Steel Flanged Box

The composite steel and concrete guideway offers a number of opportunities for guideway adaptation. The steel box section can be prefabricated and the composite top would be cast-in-place. The top flange may be manufactured from precast elements. The guideway functions identically to the concrete flanged box. A composite guideway is desired because vehicle traction and ride surface are more readily accomplished on a concrete surface than on a steel surface. This guideway type has been used in Japan, but there are no U.S. applications.

Double Plate Girder

The double plate girder uses two parallel steel plate girders with a composite concrete topping. In the configuration shown on Figure 27, the vehicle steering mechanism is on a central rail between the two main load-carrying girders. This system is used by Westinghouse at numerous installations including Tampa International Airport in Florida, Seattle-Tacoma Airport in Washington, and Busch Gardens in Williamsburg, Virginia.

Concrete Box

Concrete box options can vary from flanged boxes as shown in the first illustration to a simple rectangular box shown in the seventh illustration. There are a number of variance in between including sloping sidewalls and curved surfaces. The rectangular beam illustrated in this drawing is for a monorail such as the type used by Universal Mobility or the Walt Disney World Monorail at Orlando, Florida.

Steel Box

The steel box is used for monorail-type structures. The figure shown is similar to the Universal Mobility installation at the Minneapolis Zoo. The steel box and the concrete box are characterized by relatively small cross sections, light construction and long span capabilities. A special topping is placed on the beam to provide a traction surface.

GUIDEWAY CHARACTERISTICS

Each guideway type has a number of characteristics inherent in its basic design. Figure 28 examines several characteristics and illustrates which are the most favorable characteristics for each of the guideway types. The characteristics examined include:

- Long span capability

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St. Louis, MO

GUIDEWAY CHARACTERISTICS

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Figure 28

GUIDEWAY TYPE	LONG SPAN CAPABILITY	CURVED BEAM CAPABILITY	SUITABILITY IN NARROW STREET		SUITABILITY IN WIDE STREET WITH CENTER MEDIAN		EASE OF URBAN CONSTR.	BEAM SLENDERNESS	SNOW & ICE CONTROL	EMERGENCY EGRESS	AVAILABLE SYSTEMS
			SINGLE LANE	DUAL LANE	SINGLE LANE	DUAL LANE					
CONCRETE FLANGED BOX	●	◐	◐	○	●	◐	◐	◐	◐	●	BOEING LTV MATRA OTIS UTDC
CONCRETE DOUBLE TEE	◐	◐	◐	○	●	◐	◐	○	◐	●	BOEING LTV MATRA OTIS UTDC
CONCRETE CHANNEL	◐	○	◐	○	●	◐	◐	●	◐	●	BOEING LTV MATRA OTIS
NARROW CHANNEL	◐	○	◐	○	●	◐	◐	◐	◐	◐	WESTINGHOUSE
COMPOSITE FLANGED BOX	●	●	◐	○	●	◐	◐	○	◐	●	BOEING LTV MATRA OTIS UTDC
DOUBLE PLATE GIRDER	◐	◐	◐	○	●	◐	◐	◐	●	◐	WESTINGHOUSE
CONCRETE BOX	●	●	●	◐	●	●	○	●	●	○	UMI
STEEL BOX	●	●	●	◐	●	●	○	●	●	○	UMI

LEGEND:



FAVORABLE CHARACTERISTIC

- Curved beam capability
- Suitability in a narrow street
- Suitability in a wide street
- Ease of urban construction
- Beam slenderness
- Snow and ice control
- Emergency egress

The matrix in Figure 28 presents a visual tabulation of the results of this investigation. A solid dark circle indicates that the particular guideway type is most suitable for the characteristics listed. The half-open circle indicates that the beam has a lower capability to meet the characteristic being examined and an open circle indicates that the beam has the lowest capability to meet the characteristic. This visual system is designed to show relative differences between the beam types. The open circles should not be interpreted that a particular guideway type is unacceptable. The proper interpretation is that the guideway shape is less responsive to the objectives of the characteristic being examined than other shapes. Further refinement of this matrix would depend on a definitive statement of the objectives for each characteristic as needed in St. Louis.

Long Span Capability

Economic and urban integration considerations for guideways dictate that the typical span length be established based on the demands of the route. Specifically, the span length must be sufficient to cross the majority of streets, alleys and driveways along the route. In most cases, the span

capability will be established to include 90 percent of the beams in the project. This leaves a small number of long span beams outside the range of typical beams. Some beams are capable of having longer span capabilities through increased structural capacity of the beam or modification of the internal organization of the beam. If this increase in capacity maintains the same external shape as the original beam, the beam type is marked with favorable characteristics. Those beams which have a more limited capability to provide longer than typical spans are marked less favorably.

Curved Beam Capability

The St. Louis DPM contains a number of sharp radius curves in the downtown area. For the guideway to negotiate these sharp turns, the guideway beam must have a capability to resist substantial torsion loads. Torsion or twisting loads are best resisted by closed box sections. Open sections such as C- or U-shapes are less resistant to twisting loads. A favorable characteristic in this category is a box section or a section which has the capability to absorb large twisting forces.

Suitability in a Narrow Street

An objective of the urban integration in a narrow street is to allow as much sunlight as possible to reach the street level. A second objective is to provide sufficient space between the guideway and the buildings for emergency equipment access such as might occur in a fire. In examining a street for guideway implementation, a differentiation is made between a single lane guideway and a dual lane guideway. In a narrow street, the narrow guideway is considered to be the most favorable. For a double guideway application in a narrow street, the dual lane guideway is less desirable and may be impractical or impossible.

An alternative canopy design can be made for the guideway in a narrow street. This canopy would keep rain and snow from reaching the street level. If this

objective were to be pursued in St. Louis, the wider guideways would become more favorable.

Suitability in Wide Streets With Center Medians

If the guideway is to be placed in a center median, an objective would be to have the entire guideway in the median area. In this instance, all of the guideways shapes would be deemed favorable for single lane applications. With a dual lane guideway there is a possibility of having the guideway extend over the existing streets. The wider guideways are subject to possible collision with oversized loads on the street. In this instance, the wider guideways will be slightly less favorable than the narrow guideways.

Ease of Urban Construction

The objective of urban construction is to assemble the guideway with a minimum of urban disruption. The most favorable characteristics for urban construction are those guideways which can be manufactured off-site, brought to the site, and erected with a minimum amount of temporary hardware and erection time. Wide beams, such as channels, which are stable when placed on the column tops are more favorable than beams with a very narrow base such as the box girders. Narrow box girders may require temporary erection hardware to hold them in place until the joints are completed. Hardware must be installed from scaffold or lift trucks. This means greater disruption of street use during the erection and consequently these shapes have been marked less favorable.

Beam Slenderness

Two contrasting objectives of aesthetic definition of the guideway in a city are beam slenderness and beam width. In most cases, these two objectives are mutually exclusive. If a beam is slender, then it is usually wide. If a beam is narrow, it usually has more depth. Thus, depending on the particular objective, the evaluation of this characteristic can be reversed depending on

the desired effect. Beam slenderness addresses the depth of the beam and its view from the side. It is mathematically defined as the ratio of the thickness of the beam from the top to the bottom divided by the total length of the beam. This so called "depth to span" is frequently used in engineering and architectural terms to define the relative slenderness of the beams. For this particular evaluation, a favorable characteristic is a slender beam. Consequently, the channels and the narrow boxes are calculated to be most favorable.

Snow and Ice Control

The St. Louis environment subjects the guideway to snow and ice conditions during certain portions of the year. Snow and ice can be removed by mechanical means. However, for rubber-tired AGT systems, heating appears to be the only practical means to assure that the guideway surface is free of snow and ice. Those guideways with a minimum area require less heat to remove snow. Some guideways are specifically configured to reduce the accumulation of snow and ice. The most favorable guideway types are those which minimize heat requirements or snow and ice accumulation.

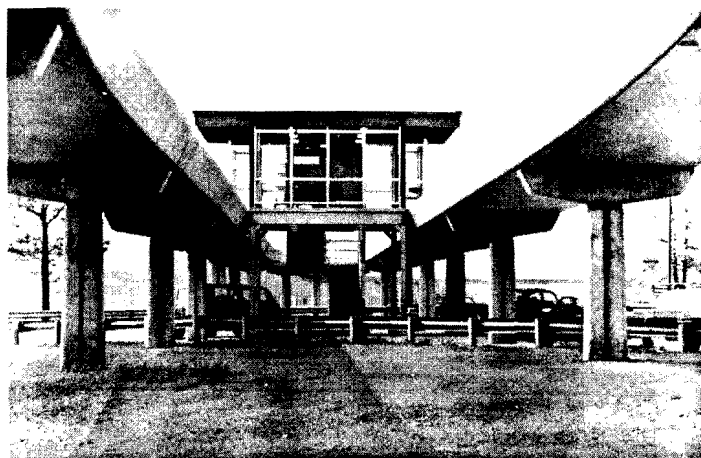
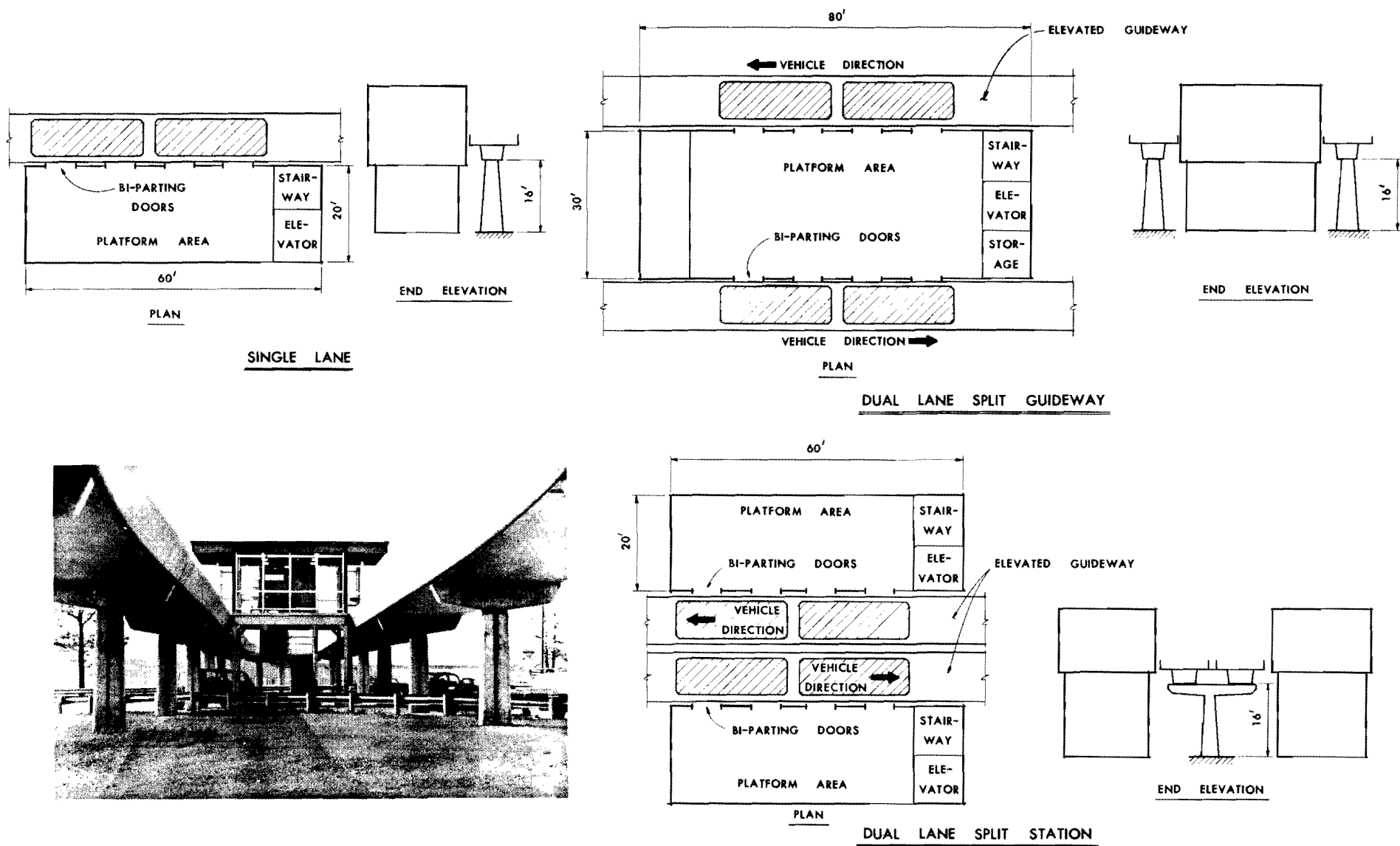
Emergency Egress

Emergency egress may be provided by a supplemental emergency walkway or by walking down the length of the guideway. The high reliability displayed by automated guideway transit systems indicates that the guideway may be successfully used as a walkway. A supplemental walkway placed on the side of the guideway has a tendency to substantially reduce the architectural appearance of the structure. Those guideways having sufficient width to serve as a functional and safe walkway are marked as the most favorable.

BASIC STATIONS

The three basic station configurations for a DPM system are shown in Figure 29. All of the stations shown are freestanding. The stations are

BASIC STATION CONFIGURATION



Downtown People Mover
Feasibility Study
St. Louis, MO
Figure 29

Booker/Bernard Johnson

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individual structures and have not been integrated into existing buildings or the guideway. One station concept is shown for a single-lane guideway and the other two stations concepts are for dual-lane guideways. All of the stations shown have berthing facilities for a two-car train of medium-size vehicles. Each station has four bi-parting doors, two-doors per vehicles. All three of the station configurations have a stairway and elevator for access to the platform level from the street level. The station platform height is determined on a minimum height of 16 feet to the beam soffit, plus allowances for the beam depth and the height of the vehicle floor from the vehicles wheels.

Single-Lane Station

The single-lane station shown in Figure 29 is 60' x 20' with a platform area of 1000 ft². The single-lane station platform has a maximum capacity of approximately 150 passengers using a passenger space of 6.0 ft²/passenger. Because the capacity of a two-car train with medium-size vehicles is approximately 130 passengers the station platform has the capacity of a two-car train. Assuming two minute headways, the single-lane is capable of handling 4000-5000 passengers per hour.

Dual-Lane Split Guideway

The dual-lane split guideway station shown in Figure 29 has a platform area of 1800 ft² and the overall platform level size is 30' x 80'. This station has bi-parting doors on both sides of the structure to accommodate dual-lane traffic in either direction. Using the 6.0 ft²/passenger space allocation, this station has a capacity of approximately 300 passengers in the platform area. The dual lane split guideway requires the two dual-lane guideway beams typically supported on a single column and footing to split into two single lane guideways around the station. There is a slight increase in the guideway cost due to the increase in columns and footings for two single-lane guideways.

Dual-Lane Split Station

The dual-lane split station shown in Figure 29 is basically two single-lane stations on either side of a dual-lane guideway. The station platform area of 2000 ft² has approximately the capacity of the arriving vehicle.

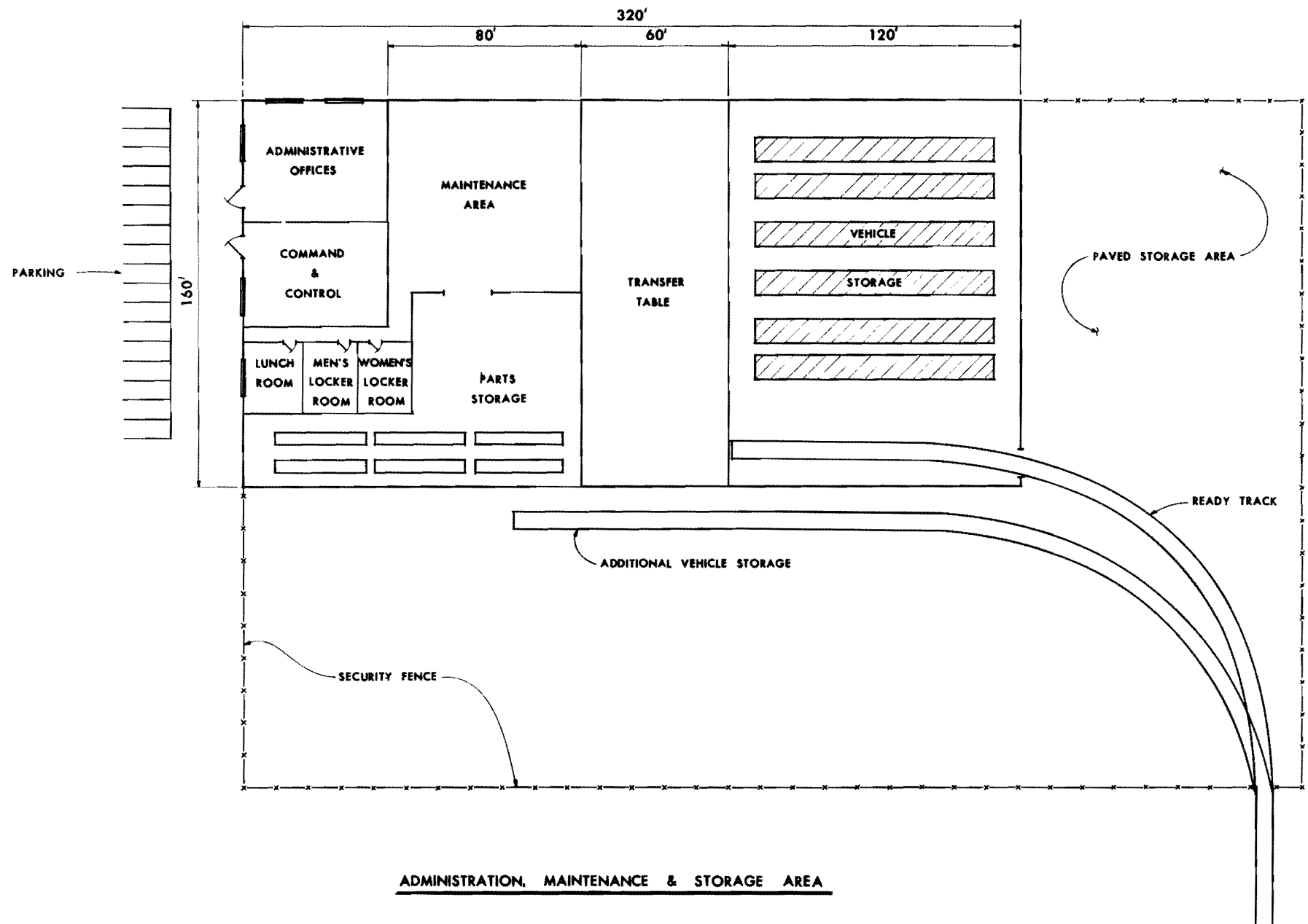
Therefore, vehicle capacities and headways and not the station capacities limit the passenger volumes through the stations. One advantage of the dual-lane split station is the use of a single column and footing for the dual-lane guideway through the station.

For all of the stations which are not integrated into existing structures the urban disruption and space requirements may place some restrictions on the DPM corridor both during and after construction. Because the guideway structure is usually located in the street right-of-way, the stations will also be located in a portion of the street. Partial street closures and re-routing of the traffic may be required near these stations due to their intrusion in the traffic lanes. One solution for narrow street widths in which the guideway and stations use a large percentage of the street right-of-way may be the use of the street as a pedestrian mall.

SUPPORT FACILITIES

A plan layout of the administration maintenance and storage facility is shown in Figure 30. The 160' x 320' (51200 ft²) building would require approximately a four acre parcel of land for the building and outside storage area. This facility would house the command and control system for the vehicles, the administrative offices, vehicle storage, vehicle maintenance and shop and parts storage.

The 2700 ft² command and control center would provide space for the vehicle computer control system and vehicle monitoring system. All of the vehicle networking and routing would be controlled from this facility. A full-time staff would be required during operating hours. The 3000 ft² administrative offices would provide space for the labor force required to



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Figure 30

Booker/Bernard Johnson

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operate and maintain the DPM system. Personnel in the administrative office would include the system manager; the operations and maintenance office would include the system manager, operations and maintenance supervisor, safety supervisor, security personnel, secretarial staff, and maintenance technicians.

The inside vehicle storage is for 12 large vehicles. Additional vehicle storage is located outside on an at-grade siding. A vehicle brought in for storage or maintenance enters the building on the ready track and is placed on the transfer table. The transfer permits later movement of vehicles in the building from the ready track to the maintenance or inside storage area.

The estimated cost of this facility is \$2,769,000 which includes the cost of the building, the mechanical and electrical systems, and the area site work. The cost of the facility also includes the at-grade guideway for the vehicles to enter the building and an initial parts inventory and acquisition costs are discussed elsewhere.

CONSTRUCTION, OPERATIONS AND MAINTENANCE COSTS

A breakdown of the total estimate costs for the four Alternative Alignments is shown in Figure 31. (Throughout the remainder of the report the candidate alignments will be referred to simply as Alignments 1, 1A, 2, 3, 4, and 4A.) The guideway costs are given in 1980 dollars and have not been escalated to the actual construction year. This cost breakdown is based on the major cost components of a guideway system. The cost breakdown is also divided into three vehicle size categories since the number of vehicles required for a given route varies significantly due to the different vehicle capacities. Vehicle fleet size has a pronounced effect on the operation and maintenance costs.

The first cost component in the cost estimate is the right-of-way acquisition. Since the right-of-way acquisition is site specific, no unit cost has been included. Plus, the right-of-way used for the DPM system is

Downtown People Mover
Feasibility Study
St. Louis, MO

GUIDEWAY COST
(1980 \$)

Booker/Bernard Johnson



Figure 31

				ROUTE 1			ROUTE 2						
COST COMPONENT	UNITS	NUMBER OF UNITS	COST PER UNIT	COST			UNITS	NUMBER OF UNITS	COST PER UNIT	COST			
				SMALL VEHICLE	MEDIUM VEHICLE	LARGE VEHICLE				SMALL VEHICLE	MEDIUM VEHICLE	LARGE VEHICLE	
RIGHT OF WAY ACQUISITION	-	-	-	400,000	400,000	400,000	-	-	-	400,000	400,000	400,000	
UTILITY RELOCATION	LS	-	-	1,000,000	1,000,000	1,000,000	LS	-	-	1,000,000	1,000,000	1,000,000	
DEMOLITION	LS	-	-	500,000	500,000	500,000	LS	-	-	500,000	500,000	500,000	
STREET MODIFICATION	LS	-	-	500,000	500,000	500,000	LS	-	-	500,000	500,000	500,000	
ELEVATED GUIDEWAY													
FOUNDATION & COLUMNS	EA	285	20,200	5,757,000	5,757,000	5,757,000	EA	255	20,200	5,151,000	5,151,000	5,151,000	
BEAMS (BASELINE CONFIGURATION)	LF	17,100	400	6,840,000	6,840,000	6,840,000	LF	15,300	400	6,120,000	6,120,000	6,120,000	
FINISHING	LF	17,100	50	855,000	855,000	855,000	LF	15,300	50	765,000	765,000	765,000	
SPECIAL STRUCTURES	LS	-	-	1,368,000	1,368,000	1,368,000	LS	-	-	1,224,000	1,224,000	1,224,000	
ADMINISTRATION, MAINTENANCE & STORAGE FACILITY	EA	1	2,769,000	2,769,000	2,769,000	2,769,000	EA	1	2,769,000	2,769,000	2,769,000	2,769,000	
BASIC STATIONS	EA	9	775,000	6,975,000	6,975,000	6,975,000	EA	6	775,000	4,650,000	4,650,000	4,650,000	
FARE COLLECTION & SECURITY	-	-	-	-	-	-	-	-	-	-	-	-	
VEHICLES													
SMALL	EA	95	103,000	9,785,000	-	-	EA	75	103,000	7,725,000	-	-	
MEDIUM	EA	22	524,000	-	11,528,000	-	EA	18	524,000	-	9,432,000	-	
LARGE	EA	14	700,000	-	-	9,800,000	EA	12	700,000	-	-	8,400,000	
ELECTRIFICATION	LF	17,100	250	4,275,000	4,275,000	4,275,000	LF	15,300	250	3,825,000	3,825,000	3,825,000	
ENGINEERING COST	LS	-	-	1,594,000	1,594,000	1,594,000	LS	-	-	1,361,000	1,361,000	1,361,000	
CONSTRUCTION MANAGEMENT	LS	-	-	2,125,000	2,125,000	2,125,000	LS	-	-	1,814,000	1,814,000	1,814,000	
SYSTEM MANAGEMENT	LS	-	-	1,125,000	1,126,000	1,126,000	LS	-	-	924,000	1,061,000	978,000	
ADMINISTRATION & LEGAL	LS	-	-	1,231,000	1,233,000	1,231,000	LS	-	-	1,039,000	1,090,000	1,059,000	
CONTINGENCY	LS	-	-	11,775,000	12,258,000	11,779,000	LS	-	-	9,942,000	10,416,000	10,129,000	
TOTAL ESTIMATED COST				58,874,000	61,291,000	58,894,000	TOTAL ESTIMATED COST				49,709,000	52,078,000	50,645,000

				ROUTE 3			ROUTE 4						
COST COMPONENT	UNITS	NUMBER OF UNITS	COST PER UNIT	COST			UNITS	NUMBER OF UNITS	COST PER UNIT	COST			
				SMALL VEHICLE	MEDIUM VEHICLE	LARGE VEHICLE				SMALL VEHICLE	MEDIUM VEHICLE	LARGE VEHICLE	
RIGHT OF WAY ACQUISITION	-	-	-	400,000	400,000	400,000	-	-	-	400,000	400,000	400,000	
UTILITY RELOCATION	LS	-	-	1,000,000	1,000,000	1,000,000	LS	-	-	1,000,000	1,000,000	1,000,000	
DEMOLITION	LS	-	-	500,000	500,000	500,000	LS	-	-	500,000	500,000	500,000	
STREET MODIFICATION	LS	-	-	500,000	500,000	500,000	LS	-	-	500,000	500,000	500,000	
ELEVATED GUIDEWAY													
FOUNDATION & COLUMNS	EA	343	20,200	6,929,000	6,929,000	6,929,000	EA	337	20,200	6,808,000	6,808,000	6,808,000	
BEAMS (BASELINE CONFIGURATION)	LF	20,600	400	8,240,000	8,240,000	8,240,000	LF	20,200	400	8,080,000	8,080,000	8,080,000	
FINISHING	LF	20,600	50	1,030,000	1,030,000	1,030,000	LF	20,200	50	1,010,000	1,010,000	1,010,000	
SPECIAL STRUCTURES	LS	-	-	1,648,000	1,648,000	1,648,000	LS	-	-	1,616,000	1,616,000	1,616,000	
ADMINISTRATION, MAINTENANCE & STORAGE FACILITY	EA	1	2,769,000	2,769,000	2,769,000	2,769,000	EA	1	2,769,000	2,769,000	2,769,000	2,769,000	
BASIC STATIONS	EA	8	775,000	6,200,000	6,200,000	6,200,000	EA	11	775,000	8,525,000	8,525,000	8,525,000	
FARE COLLECTION & SECURITY	-	-	-	-	-	-	-	-	-	-	-	-	
VEHICLES													
SMALL	EA	110	103,000	11,330,000	-	-	EA	110	103,000	11,330,000	-	-	
MEDIUM	EA	24	524,000	-	12,576,000	-	EA	24	524,000	-	12,576,000	-	
LARGE	EA	18	700,000	-	-	12,600,000	EA	18	700,000	-	-	12,600,000	
ELECTRIFICATION	LF	20,600	250	5,150,000	5,150,000	5,150,000	LF	20,200	250	5,050,000	5,050,000	5,050,000	
ENGINEERING COST	LS	-	-	1,729,000	1,729,000	1,729,000	LS	-	-	1,849,000	1,849,000	1,849,000	
CONSTRUCTION MANAGEMENT	LS	-	-	2,305,000	2,305,000	2,305,000	LS	-	-	2,465,000	2,465,000	2,465,000	
SYSTEM MANAGEMENT	LS	-	-	1,318,000	1,418,000	1,420,000	LS	-	-	1,810,000	1,410,000	1,412,000	
ADMINISTRATION & LEGAL	LS	-	-	1,371,000	1,408,000	1,409,000	LS	-	-	1,428,000	1,465,000	1,466,000	
CONTINGENCY	LS	-	-	13,105,000	13,450,000	13,457,000	LS	-	-	13,660,000	14,006,000	14,013,000	
TOTAL ESTIMATED COST				65,524,000	67,252,000	67,286,000	TOTAL ESTIMATED COST				68,300,000	70,029,000	70,063,000

proposed to be the existing street right-of-way and therefore no added cost would be associated with the DPM system. A right-of-way cost may be associated with land acquisition or easements for maintenance areas, unit substations and passenger stations. These costs would be about the same for all of the systems and therefore do not affect the selection process. An allowance of \$400,000 is included in total cost compilation to better define the total system price. This cost represents an acquisition cost for a four acre maintenance area at a land price of between \$2.00 and \$2.50 per square foot.

The next three cost components of the cost estimate, utility relocation, demolition and street modification are also extremely site dependent. A detailed study of the routes was not performed, thus, the costs used in this estimate were taken from several other transit studies. The St. Paul DPM Preliminary Design Study and a Vancouver B.C. transit study were used to generate average cost per foot of route length for each of these three components. By using an average route length of the four alignments a lump sum cost for each component is included in the four cost estimates.

The next component in the cost estimate is the elevated guideway structure. The elevated structure includes the foundations, columns, beams and finishing. Due to the poor soil condition in the St. Louis area, a drilled caisson foundation was assumed for the cost estimate baseline. The column used in the cost estimate was a precast concrete column and crosshead. The cost estimate for the foundation and columns represents the total in-place cost including materials and labor, shipping, overhead, profit and contingencies. The beam cost estimate is based on a precast concrete beam. The cost estimate includes the labor and material for precasting the beam, shipping the beams to the construction site, labor and equipment for erecting the beams onto the columns and the contractor overhead and profit. The finishing component of the cost estimate reflects the cost of obtaining the required tolerance of the ride surface along with the cost of installing key elements of the guideway vehicle interface such as power rails and switches.

The cost estimate also includes a cost allowance for special structures. This cost was assumed to be 20 percent of the beam cost for all of the alternatives alignments. It includes the cost of items such as long-span beams that may be required for some street crossing. The special structures cost also includes the cost of the guideway intersections and switches. One item not included in any of the cost components is the cost of keeping the guideway free of snow and ice by either mechanical removal of guideway heating. This is a system dependent cost and no accurate data is available to predict what this cost is or whether it should be included.

The cost of the administration maintenance and storage facility is included in the estimate for four alignments. This estimate includes the cost of the building with heating and lighting, the area site work, fencing and the at-grade guideway required to bring the vehicles into the building. The cost of this facility also includes a parts inventory for maintaining the vehicles equivalent to the cost of two vehicles.

Cost estimates for the guideway stations have been included as a components of the guideway cost estimate. The basic station costs include the foundation and building framing, the mechanical and electrical units, lighting, vertical movement facilities and bi-parting doors. Not included in the station costs are the costs for a fare collection or security system.

The electrification component of the total guideway cost includes the cost of the power distribution system, three rail, three phase power rails and insulators installed on the guideway. The source of the electrical and station ws the AGT Guideway and Station Technology, Guideway and Station Review, Volume 7.

The engineering cost and construction management fee were determined from a percentage of the construction cost. The engineering cost is six percent and the construction management is eight percent of the utility relocation, demolition, street modification, elevated guideway, administration maintenance and storage facility and stations. The system management cost is

eight percent of the vehicle and electrification cost and the administration and legal cost being three percent of the total engineering, construction and system costs. A 25 percent contingency is included to reflect preliminary stage of the design and cost estimating.

ECONOMIC AND DEVELOPMENT IMPACTS

The evaluation of the St. Louis DPM candidate alignments included the determination of economic and development impacts associated with each alignment. Utilizing available relevant data sources, interviews, and reconnaissance information, the analysis compared the relative strengths and weakness of alternatives. In this manner, an evaluation of specific market service parameters and alignments was not required. This allowed for comparison of alignments without the need for detailed analysis of specific economic indicators that are both difficult to collect at this level of analysis and may not effectively measure differences due to the similarity of alignments in a restricted area.

METHODOLOGY

Three key features of development impacts associated with DPM systems were analyzed in this study: 1) impacts on existing development; 2) linkages of present and proposed CBD activities; and 3) expansion and creation of potential new development.

Impacts on existing development were measured by comparing aggregate system data for the following variables: 1) percentage of CBD employment served; 2) CBD retail floor space served; 3) number of Class A CBD hotel rooms served; and 4) number of spaces in parking structures served. These data were used as surrogate measures to more detailed economic evaluative measures such as multiplier effects and job generation measures. Because the candidate alignments operate in an area as geographically restricted as a CBD, the classic economic indicators are less effective due to proximity of station locations and the uncertainty of small area estimates. Also, these surrogate

measures tend to reflect more easily understood and workable indicators of DPM impacts.

The second feature of development impacts studied was the linkages of downtown activity centers that are served by the proposed DPM system. A critical opportunity provided by DPM systems is the ability to link activities and uses that were formally difficult to access due to distance or other physical barriers. For instance, the provision of access from a perimeter employment area to a downtown retail or restaurant area can significantly impact the sales potential of the retail area. This new access provided tends to foster trip-making that would not have occurred without a downtown circulation system such as a DPM. The analysis of activity centers or areas that are served and linked by a DPM is therefore an important element in the overall economic analysis of a proposed DPM system.

The methodology used to make the activity center determinations involved overlaying candidate alignments on the 1985 development scheme to determine important generators and attractors that are served by each candidate alignment as well as generators and attractors that are not served. A comparison of alignments and the number of activity areas that are served allowed for a more complex understanding of the possible benefits and constraints of each candidate alignment.

The final area of development impacts that were analyzed focused on the expansion or creation of potential new development associated with a DPM system. This focused on the determination of short term and long term joint development potential at individual stations. Each station was evaluated individually and then summarized to compare the relative merits of alternative system alignments. The following evaluation criteria were used to assist in the determination of short term and long term joint development potential: existing land uses, present market image, plans and proposals, and future market image. After a determination of each station area's joint development potential, the candidates alignments were compared in different

ways to determine the alignments most likely to generate new joint development.

The analysis of each of these three features of development impacts: impacts on existing development; linkages of activities; and expansion of potential joint development, is summarized in the following sections.

IMPACTS ON EXISTING DEVELOPMENT

The service characteristics of the candidate DPM alignments in relation to impacts on the 1985 CBD development scheme is listed in Table 12. As aggregate indicators, these four characteristics are surrogate measures for economic indicators that are frequently used to determine impacts on existing developments. As shown in the table, these four indicators give a generalized description of the relationship of the candidate alignments to important CBD development characteristics. Reviewing these data, it is clear that Alignments 4 and 4A are markedly superior to the other candidates alignments. Alignment 4 serves almost the entire CBD employment base, while Alignment 1 serves approximately 80 percent and Alignments 2 and 3 serve only 70 percent of the employment base. This indicator is critical to the success of the DPM system because the DPM system has the potential to facilitate many new trips by CBD employees to other destinations within the CBD that formally would not be considered as viable destinations by employees. The fact that Alignment 4 serves such a large percentage of the CBD employment base indicates the potentials associated with this alignment in terms of circulation, development, and CBD access.

Alignment 4 also serves the retail areas better than other alignments. The retail sector is generally in the central area of the CBD and is well served by these two alignments. The other alignments serve 70 percent (Alignment 3) to 87 percent (Alignment 1) of the retail base. The combined effect of serving almost the entire employment base, as well as most of the retail space indicates strong central trip generation between employment areas and retail areas in the CBD.

TABLE 12
ST. LOUIS DPM FEASIBILITY STUDY
COMPARISON OF IMPACTS ON EXISTING (1985) DEVELOPMENT

Characteristics	Alternative Alignment					
	<u>1</u>	<u>1A</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>4A</u>
% CBD Employment Served	82%	82%	69%	71%	95%	98%
CBD Retail Floor Space Served (millions of sq.ft)	3.075 (87%)	NA	2.970 (84%)	2.435 (69%)	3.480 (97%)	3.500 (98%)
# of Class A CBD Hotel Rooms Served	6,300 (100%)	NA	2,800 (44%)	5,350 (85%)	6,300 (100%)	6,300 (100%)
# of Spaces in Parking Structures Served	19,000	NA	12,000	18,250	20,700	20,700

NA - not available

SOURCE: Robert J. Harmon & Associates, Inc.; Booker Associates, Inc.; Bernard Johnson, Inc.

Alignment 1, 4, and 4A serve the entire range of Class A CBD hotel rooms. Alignment 3 serves 85 percent, while Alternative 2 serves less than half of the CBD hotel rooms. Because visitors to the CBD represent significant potential ridership on a DPM system, the fact that these alternatives serve all of the Class A downtown hotel space makes any of these three alternatives more appropriate than Alignments 2 or 3.

It is also important that the DPM system serves parking areas in the CBD in order to attract non-CBD users to the downtown and provide them access to retail and other CBD activities without having to use their vehicle for internal CBD trips. This can improve street circulation, noise levels, and air quality levels. As similar to other measures, Alignment 4 provides the best access of all the candidates alignments. At the other end of the spectrum, Alignment 2 provides access to barely half as many parking spaces as this alignment.

Alignment 1 and 3 provide a comparable access to parking, but not at the level of Alignment 4.

In summary, it is apparent that in terms of the existing 1985 development format in the St. Louis CBD, both Alignment 4 and 4A provide significantly better service to the four characteristics surveyed than the other alternative alignments. It is highly significant that this alignment serves such an overwhelmingly large portion of the employment, retail activity, hotel rooms, and parking space in the CBD. This is due both to the choice of street alignment as well as the number of stations on the alignment.

LINKAGES OF CBD ACTIVITIES

The comparison of activity centers served by each candidate alignment gives a qualitative indication of the overall viability of each alignment. This will help in understanding which CBD activities are and are not served by each candidate alignment. This can assist with the selection of one alignment by enabling the analyst to more easily envision those CBD activities that are

served or are passed over by each candidate alignment. All activities of the CBD were accounted for, including special event activities, generalized areas of activity, and proposed new development. The following paragraphs describe the activities served by each alignment in the CBD.

Alignment 1, a downtown loop with a spur using either Market Street or Clark Street to St. Louis Station (Union Center), serves the following CBD activities: St. Louis Station, the government employment area, the Stadium, the First National Bank Building on IBM Plaza, the Class A hotel area, the Convention Center, and significant concentration of office and retail activity. It does not, however, serve Laclede's Landing, the Gateway Arch area, or the central part of the retail area of downtown near the Famous-Barr Department Store. In general, its coverage of the CBD is very good and it links important related activities such as the Class A hotels to the Convention Center and significant employment areas to retail areas.

Alignment 2 provides a shuttle service through downtown, from a point near Laclede's Landing to St. Louis Station. As well as serving these two activity centers, this candidate alignment serves government offices, the downtown retail core, the Old Post Office redevelopment, and the offices in the central locations of downtown. It serves very few of the Class A CBD hotels, nor does it serve the Stadium, the Convention Center, or offices on the south side of the CBD.

Alignment 3 is a shuttle service which runs on the south edge of downtown from St. Louis Station passing the Stadium and then across eastern part of the CBD to the Convention Center. This alignment serves the Plaza Square Apartments, government office buildings, the office area on the south side of the CBD, and Class A hotels. It fails to serve Laclede's Landing, the downtown retail core, the Gateway Arch, or the core office area.

Alignment 4 provides a figure 8 alignment through the center of the CBD with a shuttle spur to St. Louis Station. This Alternative serves the St. Louis Station, the government office area, the Stadium, the south side office area,

the Class A CBD hotels, the downtown central office and retail core along 8th Street, the edge of Laclede's Landing, and the Convention Center. Alignment 4A has optional routes to serve the proposed Columbus Square Apartments, direct access to Laclede's Landing, and approximate access to the Gateway Arch. Alignment 4A provides somewhat better CBD linkage than Alignment 4 due to the direct access provided to Laclede's Landing and the Gateway Arch. Both alignments provide maximum service to the CBD.

The final alignment analyzed was Alignment 1A, which uses 4th Street as its eastern most boundary instead of Broadway as is the case with Alignment 1. The purpose of this alteration was to examine an alignment that increases service to the Riverfront area and Laclede's Landing to take advantage of tourist trade at the Gateway Arch and possible development to the northeast of the CBD along the Riverfront, while maintaining maximum CBD service. As such, it serves all the eastern activity centers as the earlier Alignment 1 and it does provide increased access to the Gateway Arch/Riverfront area and Laclede's Landing.

A comparison of the alignments indicate that due to the maximal configuration of Alignment 4, this alternative serves the St. Louis CBD activity centers to a greater degree than any of the other alignments that have been analyzed. In descending order of service to major activity centers, Alignments 4 and 4A are the best followed by Alignments 1A, 1, 3, and 2. The linkages provided by Alignment 4 and 4A are important not only to maximize the ridership potential of the DPM but to link up important activity centers and provide impetus for expansion of these activity centers as well as creation of new development nearby.

JOINT DEVELOPMENT POTENTIAL

A total of 34 separate station locations were examined. This includes all the station areas for the candidate alignments, including the Clark Street and Market Street options west of 12th Street for Alignment 1; the Cole Street, Memorial Drive and Laclede's Landing options for Alignment 4; and the

three stations that were associated with Alignment 1A. Six of the stations are common to two of the alternatives and two are common to three of the alternatives.

In the short term, 16 of the 34 station areas are judged to represent excellent or good joint development opportunities. The long term potentials are significantly greater, with 24 of the 34 locations in the excellent or good categories. This tabulation indicates that the core area of the CBD contains a substantial number of sites with joint development potential. This is generally due to: 1) significant amounts of vacant/underutilized land; 2) the existence of important activity centers scattered throughout the CBD; 3) the potential interface with existing and/or committed buildings; and 4) the CBD access created by the DPM system.

The primary emphasis on this analysis is on individual station areas, but only as part of an attempt to: 1) ensure that the candidate alignments can provide sufficient joint development opportunities; and 2) permit evaluation of the relative differences in potential across the several route alignment alternatives. The analysis reveals that the joint development potential of each alignment is highly correlated with the number of stations along the alignment; the greater the total of stations, the greater the likelihood of finding station areas with high joint development potential.

There are a variety of ways in which the individual station findings can be summarized to compare the relative merits of alternative system alignments. These include comparisons of alignments in terms of:

- The number of station areas with excellent long term potential;
- The number of station areas with excellent short term potential;
- The number of station areas with excellent or good long term potential;

- The number of station areas with excellent or good short term potential; and
- A composite ranking based on the number of stations in each assessment category over the short term and the long term.

Findings with respect to each of these criteria are presented on the following pages and shown in Table 13 and Figure 32. The evaluation results, in terms of the total number of stations with above average potential, indicate that Alignment 4A is the most preferable and Alignment 2 presents the smallest number of attractive joint development opportunities. However, it should be noted that Alignment 2 compares favorably in terms of the percentage of stations with above-average potential. Within Alignment 1, the Market Street option is marginally preferable to the Clark Street alignment west of Tucker Boulevard, but the difference is too small to be of any practical significance. The distinction between Alignments 4 and 4A is more obvious and substantial, especially over the short term.

The composite score is a comprehensive overall index of joint development potential which reflects both positive and negative ratings and provides a single figure of merit for direct comparison. The danger inherent in using this composite is that, if one assumes relatively finite amounts of new development attributed to DPM implementation, additional stations with poor or even average potential will not expand total development. Conversely, it can be argued that there are factors other than the ones evaluated herein that will determine the loci of development and that the more location options available under a given alternative (even if some of them are below average), the greater the possibility that development opportunities will come to fruition. For example, the composite scores of Alignment 4A are the highest while Alignment 2's are the lowest. However comparing the average composite score per station, Alignment 1A is the highest and Alignment 4 is the lowest. By using the composite scores as the basis of comparison, alignments with the most station locations have a distinct advantage. Alignments with a greater number of stations should not be penalized in the

TABLE 13
ST. LOUIS DPM FEASIBILITY STUDY
SUMMARY OF JOINT DEVELOPMENT POTENTIAL
FOR EACH CANDIDATE ALIGNMENT

<u>Station Characteristics</u>	<u>Alternative Alignments</u>						
	<u>1A</u>	<u>1 (Market Street)</u>	<u>1 (Clark Street)</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>4A</u>
Total Number of Stations	10	9	9	6	8	11	13
No. Stations w/Excellent Long Term	4	3	3	0	1	2	2
No. Stations w/Excellent Short Term	4	3	3	2	2	2	4
No. Stations w/Excellent or Good Long Term	7	6	6	5	6	7	8
No. Stations w/Excellent or Good Short Term	4	4	4	3	5	3	6
Composite Score* - Short Term	35	29	28	20	25	29	40
Average per Station	3.5	3.2	3.1	3.3	3.1	2.6	3.1
Composite Score* - Long Term	37	33	32	20	25	35	42
Average per Station	3.7	3.7	3.6	3.3	3.1	3.2	3.2

* Score based on values as follows:

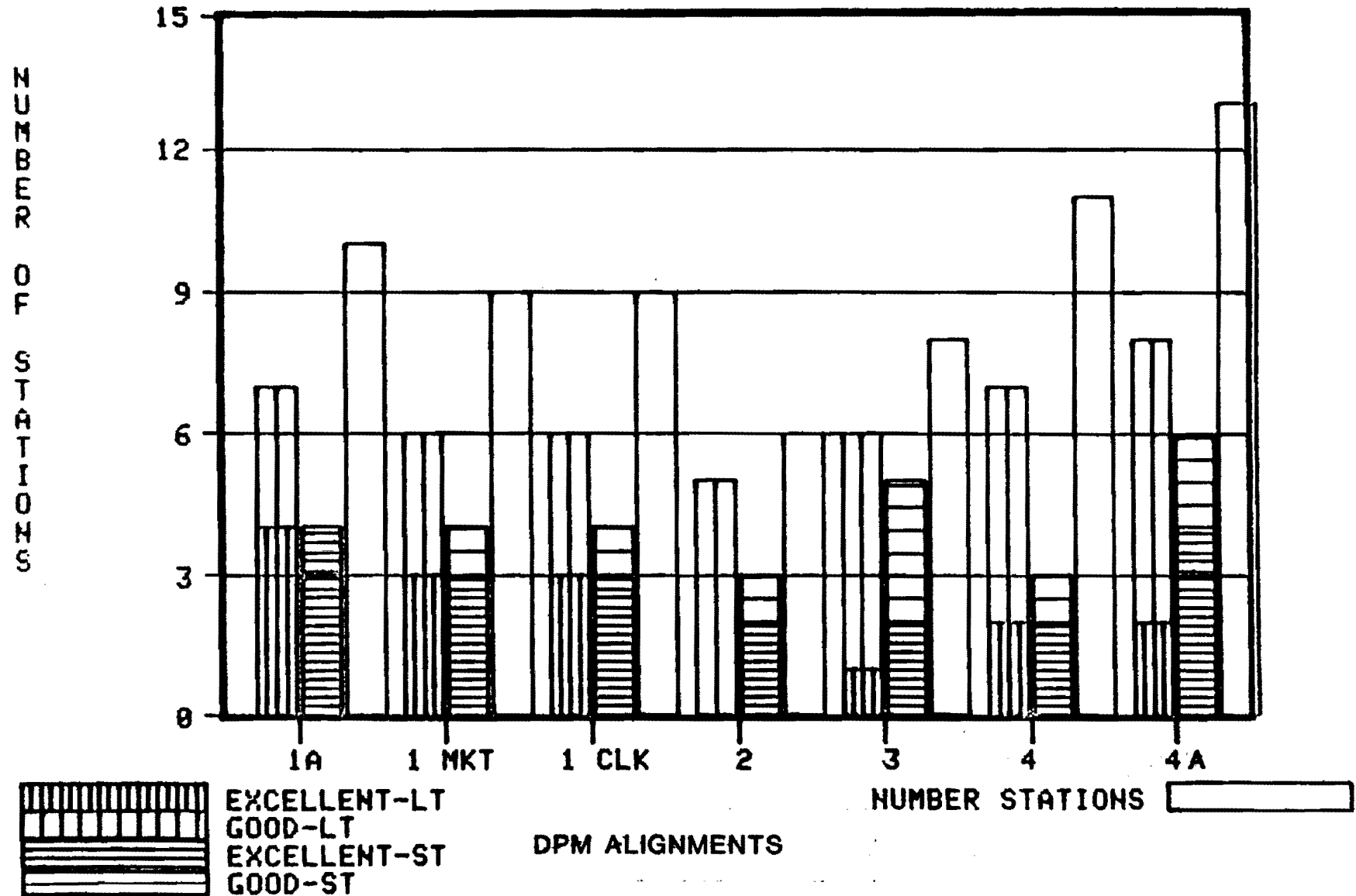
Excellent = 5; Good = 4; Fair = 3; Poor = 2; Very Poor = 1; Unalterable = 0

SOURCE: Robert J. Harmon & Associates

Figure 32

St. Louis DPM Feasibility Study

RATINGS OF JOINT DEVELOPMENT POTENTIAL BY ALIGNMENT
DISTRIBUTION OF RATINGS - LONG VS SHORT TERM



present analysis; the cost effectiveness analysis is the proper place for consideration of the relative merits of the number of stations as a factor in alignment choice.

There are other issues that will affect the final development potential of each alignment. The evaluations to date have been performed on a station by station basis (i.e., taking each location independently of others). Obviously there will be some interactive effects, especially among adjacent stations, whereby intensive development at one station may enhance or diminish the potential at neighboring stations. A more comprehensive market analysis of: 1) the joint development potential of each station location; 2) the composite potential of the selected alignment; and 3) the "fine tuning" of specific station locations, would require a much more detailed analysis. This will be performed in Phase II, of the study, when the final alignment has been designated.

Public sector response to development potential at station locations will also significantly impact development. Public sector response can vary from a laissez-faire attitude to intensive involvement (planning, control or fiscal) by the public sector. The key difference between passive and aggressive assistance revolves largely around public sector institutional, financial, and capital assistance.

Passive policies are generally in the form of policies or zoning changes that would accommodate land use changes around DPM stations. A more aggressive public posture would be to actively encourage transit-related development in the form of: the creation of a special development corporation with powers to facilitate development, infrastructure improvements, and/or financial assistance. The aggressive public policy can greatly impact the intensity or character of development around DPM stations. An aggressive public policy is likely to provide the stimulus necessary for private developers to consider new development in the CBD. The reduction of a developer's uncertainties or front end costs in terms of permit requirements, infrastructure requirements,

etc. can heighten private interest and facilitate development in areas or projects not formerly considered feasible by the private sector.

Joint development opportunities are a very important dimension of any decision to proceed with a DPM system and of the final choice of alignment and station locations--as shown by the development-related impacts projected in other DPM cities and by the high importance attached to such potential in ratings by the TRC. However, it must be stressed that numerous other factors and criteria (e.g., enhancement of existing commercial facilities and economic activity, cost, physical and engineering constraints, access and linkage of key activity nodes, transportation issues and interfaces, patronage, environmental concerns, etc.) are involved in the selection of alternative and in final feasibility assessment. A system configuration which overemphasizes joint development would almost certainly yield lower initial patronage and other deficiencies in comparison with a configuration based on a balanced selection process.

RELATIONSHIP TO ACTIVITY CENTERS

Alignment 1 provides good central circulation and serves various activity centers along Walnut, Broadway, Convention Center Plaza, and Tenth Streets. Future activity areas adjacent to Union Station would be served by a spur.

Alignment 2 provides service through the core area of downtown. It would serve Laclede's Landing and areas adjacent to Washington Avenue, Seventh and Olive Streets, a short segment of Tucker Boulevard and future area adjacent to Union Station.

Alignment 3 serves the activity areas on the fringes on downtown. Areas along Broadway, Walnut Street, and a short segment of Convention Center Plaza will be served best. Future activities at Union Station will also be served.

Alignment 4 provides excellent circulation to both the fringe and core areas. Activity areas along Fourth and Eighth Streets, Tucker Boulevard, Walnut

Street, and Convention Center Plaza will be highly visible and afforded excellent service. A spur will serve areas adjacent to Union Station.

PARKING AND COMMUTER INTERCEPT

Figure 32A presents the location of the major CBD parking facilities as they presently exist.

Alignment 1 provides excellent opportunity for the DPM to intercept commuters before they penetrate the core. The following parking lots/structures are adjacent to the alignment: Union Station, Keil, Stadium Garages "G", "E", and "B" and the surface lots near the Convention Center.

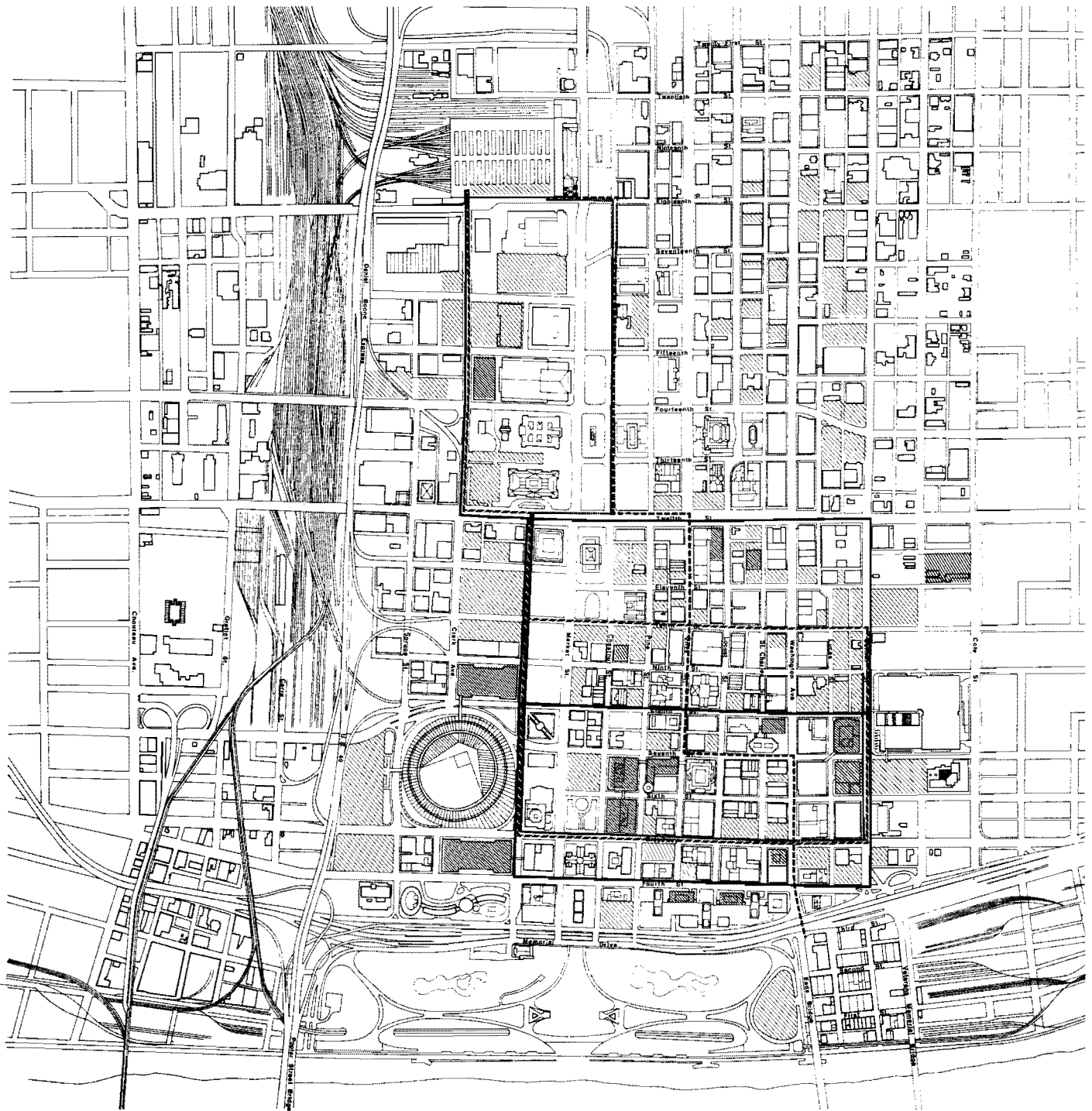
Alignment 2 would be adjacent to the following parking lots/structures: Union Station, minor areas on Tucker Boulevard, and areas in the vicinity of Laclede's Landing. This alternative will not allow a good commuter intercept program.

Alignment 3 provides DPM access to the following parking lots/structures from which commuters could utilize before centering the core area. These lots are at Union Station; Stadium Garages "G", "B", and "E" and lots adjacent to the Convention Center.

Alignment 4 allows for good commuter intercept, because the alignment will be adjacent to the following parking lots/structures: Union Station, Keil, Stadium Garages "G" and "E", Laclede's area, Convention Center, and minor areas on Tucker Boulevard.

PATRONAGE ESTIMATES

The following section compares patronage levels of the four candidate DPM alignments. The method used to develop the patronage numbers is an aggregate analysis applying tables developed for DPM projects by UMTA and published in Chapter VI of DPM: Planning for Downtown People Movers, Volume I,



Downtown People Mover Feasibility Study

Booker / Bernard Johnson

Figure 32A

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

Legend

-  One level (either at ground or rooftop)
-  Parking Structure
-  Alternate Alignment 1
-  Alternate Alignment 2
-  Alternate Alignment 3
-  Alternate Alignment 4

PARKING FACILITIES



DOT/Transportation Systems Center for UMTA, April 1979 (see Appendix B.) With judgement, this method allows a "first cut" estimate of system patronage for a relatively small investment in time or resources. These numbers allow for comparisons of various alternatives and will likely change as more detailed analysis is done at later stages.

Table 14 provides a summary of the patronage analysis, and shows the service provided to employment in the downtown area as well as average daily patronage estimates for 1985 and 1995.

TABLE 14
ST. LOUIS DPM FEASIBILITY STUDY
SUMMARY, ST. LOUIS DPM PATRONAGE ANALYSIS
AVERAGE WEEKDAY RIDERSHIP

	<u>1985 Employ- ment Served</u>	<u>1985 Daily Patronage</u>	<u>1995 Daily* Patronage</u>
Alignment 1	82%	40,800	49,800
Alignment 1A	80%	41,600	50,800
Alignment 2	69%	31,500	38,400
Alignment 3	71%	33,800	41,200
Alignment 4	95%	46,700	57,000
Alignment 4A	98%	50,700	61,900

* 1995 figure based on factoring employment 1995/1985,
 $125,725/103,244 = 1.22$.

Alignment 1 is a downtown loop with nine stations and a spur to Union Center. As shown in Table 14, it serves 82 percent of 1985 employment and attracts the second-highest patronage of 40,800 average daily for 1985. This

alternative provides for good central circulation, serves hotels and activity centers, and allows for distribution of regional trips. Alignment 1A provides enhanced hotel access and attracts 41,600 average daily patrons in 1985.

Alignment 2 provides a shuttle service through downtown from Laclede's Landing to Union Center and has six stations. Alternative 2 serves 69 percent of the employment and attracts 31,500 daily patrons in 1985. This alignment offers good downtown distribution for regional trips, ending at Union Center or Laclede's Landing, but does not provide downtown circulation for the Convention Center and hotels.

Alignment 3 is a shuttle service which runs on the edge of downtown, connecting Union Center and the Convention Center with eight stations. This configuration serves 71 percent of the employment and attracts an estimated 33,800 daily patrons in 1985. This alternative links many hotels and activity centers and serves fringe parking quite well but fails to penetrate a large portion of the existing high-density downtown areas.

Alignment 4 provides a figure-eight service to the center of downtown with a spur to Union Center. Two versions of this alternative were analyzed, with eleven and thirteen stations serving 95 percent and 98 percent of the employment and attracting 46,700 and 50,700 daily patrons, respectively. This alternative serves the fringe as well as the central portion of downtown and offers good circulation between hotels and activity centers.

PATRONAGE ESTIMATION METHODOLOGY

As referenced earlier, the patronage analysis for the St. Louis DPM system takes advantage of a substantial volume of work done specifically for the DPM program. Chapter IV of the UMTA document provides tables based on average characteristics of many cities which can be applied with judgement to estimate likely DPM markets for the St. Louis system. In addition, where available, local information can be substituted and the forecasting accuracy

thereby improved. Tables used in this analysis are provided in the Appendix B.

The St. Louis DPM system will attempt to attract two basic types of trips: those trips coming to the downtown area in need of distribution to their final destinations, and those trips which are internal circulation trips within the downtown area. The methodology described in the UMTA document estimates diversions to the DPM from all available modes for these two basic types of trips. Specifically, diversions are estimated for:

- Regional Transit
- Regional Auto
- Internal Transit
- Internal Auto
- Internal Walk

In addition to diversions from these modes, an estimate is made of trips which are induced by the DPM system itself.

Total Downtown Trips

In order to predict diversions, the total number of trips by the various modes must be known. Using St. Louis data on predicted vehicle trips, employment and floor space, Table VI-3 of the UMTA document was used in estimating the following trips for downtown St. Louis in 1985:

- Regional Transit - 81,500 Average Daily Trips
- Regional Auto - 151,000 Average Daily Trips
- Internal Transit - 9,000 Average Daily Trips
- Internal Auto - 21,000 Average Daily Trips
- Internal Walk - 173,000 Average Daily Trips

Regional Transit Diversions

Diversions of transit trips to the DPM depend on many factors related to the alignment of the DPM to the transit system and the service provided to ultimate destinations. Tables VI-5 and VI-6 provide the basis for estimating diversions based on the following factors: downtown size, activity distribution, transit delivery location, number of stations, station spacing, fare, speed, and frequency.

Regional Auto Diversions

Diversions to the DPM from auto trips assume that parking is limited or expensive at the destination end of the auto trip. Downtown congestion is also a factor. The estimation Tables VI-9 and VI-10 were used to estimate regional auto diversions. Inputs to these include the amount and distribution of activities, downtown size, stations, station spacing, DPM service, fares, and frequency.

Internal Walking Trips

Internal walking trips provide a vast market but many are very short and therefore highly dependent on the physical alignment of the system. Using some assumptions on trip length distribution, Tables VI-12 and VI-13 provide the basis for this estimation. The tables include inputs of amount and distribution of downtown activity, downtown size, number of stations, station spacing, DPM speed, service, and fares.

Internal Transit Trips

The DPM diversion from local transit will naturally depend on the relative service, speed, and fares of the alignments. Table VI-14 provides guidance for estimating diversions which must be used with judgement on the amount of actual competition between these modes.

Internal Auto Trips

Short internal auto trips in the downtown area are primarily by businessmen making stops, shoppers, and taxis. The availability of the DPM might make it attractive to park one's car on the fringe and make multiple stops via the DPM. Table VI-16 provides diversion estimates based on the amount and distribution of activities, downtown size, number of stations, and station spacing. Fringe area parking capacity also plays a role.

Induced Trips

The UMTA DPM document provides empirical evidence showing that trips induced by the addition of new service such as the DPM can be estimated to be approximately 10 percent of other internal DPM trips. This is based on observations for downtown transit service in Washington, D.C., Milwaukee, and Los Angeles.

FORECASTING ASSUMPTIONS

The basic assumptions about the DPM system and downtown St. Louis are listed below:

DPM - Fare - 25¢ (10¢ also tested)
 Speed - 15 MPH
 Headway - 2 min. peak/5 min. off-peak

Transit - Fare - 50¢ Regular/75¢ Express
 Stops at DPM where feasible
 Free transfer from bus to DPM

Auto - Parking Cost - \$3.00 CBD/\$0.50 Fringe

Downtown - 1985 Employment - 103,000
1995 Employment - 126,000
Area - Approximately 1 sq. mi.
Spread activity distribution

Assumptions about each alternative are stated as the alternative is considered.

DIVERSION ESTIMATES FOR DPM ALTERNATIVES

Alignment 1

This alignment is a loop with a spur and a total of nine stations. Since six of the nine stations are on one-way links, and assuming that one-way links are 60 percent as effective as two-way, the diversion estimates will be reduced where appropriate by 25 percent to account for the reduced service per station. It is assumed that 35 percent of the regional bus trips are delivered to fringe DPM stations. The DPM is assumed to provide distribution to approximately 7,000 parking spaces. The station spacing is about 1400 feet on the average. Based Based on the tables in the Appendix, the diversion rates and trips are summarized in Table 15.

TABLE 15
ST. LOUIS DPM FEASIBILITY STUDY
1985 AVERAGE WEEKDAY DPM TRIPS: ALIGNMENT 1

<u>Trip Type</u>	<u>Total Regional Trips</u>	<u>Diversion %</u>	<u>DPM Trips</u>
Regional Transit	81,500	20	18,700
Regional Auto	151,500	10	15,100
Internal Transit	9,000	4	400
Internal Auto	21,000	4	800
Internal Walk	173,000	3	5,200
Induced		10% 3), 4), 5)	<u>600</u>
Total			40,800
	Alignment 1A		41,600

Alignment 2

This alignment is a six-station shuttle system through the center of downtown. Based on its layout, it is assumed that 25 percent of the regional bus transit ridership is terminated at fringe DPM stations. It is presumed that this alternative serves 5,000 parking spaces for distribution. The station spacing is approximately 1,260 feet on the average.

Using the tables in Appendix B, while adjusting for local conditions, the diversion rates and trips are shown in Table 16.

TABLE 16
ST. LOUIS DPM FEASIBILITY STUDY
1985 AVERAGE WEEKDAY DPM TRIPS: ALIGNMENT 2

<u>Trip Type</u>	<u>Total Regional Trips</u>	<u>Diversion %</u>	<u>DPM Trips</u>
Regional Transit	81,500	18	14,700
Regional Auto	151,500	7	10,600
Internal Transit	9,000	3	300
Internal Auto	21,000	3	600
Internal Walk	173,000	2.7	4,700
Induced		10% 3), 4), 5)	<u>600</u>
Total			31,500

Alignment 3

The third alignment is a shuttle system with eight stations which runs on the edge of the downtown area. It is presumed that 25 percent of the regional transit trips stop at fringe DPM stations. The system is assumed to serve approximately 6,000 parking spaces used for distribution. The station spacing is about 1,200 feet. The results of the analysis using the tables and adjustments are shown in Table 17.

TABLE 17
ST. LOUIS DPM FEASIBILITY STUDY
1985 AVERAGE WEEKLY DPM TRIPS: ALIGNMENT 3

<u>Trip Type</u>	<u>Total Regional Trips</u>	<u>Diversion %</u>	<u>DPM Trips</u>
Regional Transit	81,500	20	16,300
Regional Auto	151,500	8	12,100
Internal Transit	9,000	2.5	200
Internal Auto	21,000	3.5	700
Internal Walk	173,000	2.3	4,000
Induced		10% 3), 4), 5)	<u>500</u>
Total			33,800

Alignment 4

The final alternative is a figure eight configuration with a spur to Union Center. This is laid out with eleven stations, with the option of adding two additional stations. As in Alternative 1, there is a mixture of one-way and two-way lines, and adjustments to the tables are necessary. It is assumed that 35 percent of the regional bus routes terminate at fringe DPM stations and 8,000 parking spaces are served for distribution. The average station spacing is approximately 1,200 feet. The results of the analysis are shown in Table 18.

TABLE 18
ST. LOUIS DPM FEASIBILITY STUDY
1985 AVERAGE WEEKDAY DPM TRIPS: ALIGNMENT 4

<u>Trip Type</u>	<u>Total Regional Trips</u>	<u>Diversion %</u>	<u>DPM Trips</u>
Regional Transit	81,500	25	21,000
Regional Auto	151,500	11	16,700
Internal Transit	9,000	5	500
Internal Auto	21,000	4	8,000
Internal Walk	173,000	4	6,900
Induced		10% 3), 4), 5)	<u>800</u>
Total			46,700
	Alignment 4A		50,700

PLANNING CONSIDERATIONS

Weekend Ridership

Saturday ridership should average 50-60 percent of the average weekday load.
Sunday ridership should average 20-25 percent of the average weekday load.

Peak Ridership

The peak four-hour period, two hours in the a.m. and two hours in the p.m., should average 40-50 percent of the average weekday ridership.

Fare

Table 19 summarizes the results of the reduction of the DPM fare from 25¢ to 10¢.

TABLE 19
ST. LOUIS DPM FEASIBILITY STUDY
ST. LOUIS DPM AVERAGE WEEKDAY RIDERSHIP WITH 10¢ FARE

	<u>1985 Weekday</u>	<u>1995 Weekday</u>
Alignment 1	51,400	62,700
Alignment 1A	52,400	63,900
Alignment 2	39,700	48,400
Alignment 3	42,600	52,000
Alignment 4	58,800	71,700
Alignment 4A	63,900	78,000

POTENTIAL PASSENGER REVENUE

Table 20 lists the annual passenger revenue for all the alignments. These numbers were derived by applying the following assumptions to the patronage numbers:

- 25 cent fare;
- Free transfer from bus to the DPM system;
- 255 weekdays in the year;
- 52 Saturdays in the year;
- 52 Sundays in the year; and
- 6 Holidays.

In order to derive the number of fare paying passengers, the regional transit passengers were subtracted from the average weekday DPM trips. Saturday

ridership should average 50-60 percent of the average weekday load, 55 percent was used for calculations in Table 20. Sunday ridership should average 20-25 percent of the average weekday load, 22 percent was used in Table 20. Holidays were treated as Sundays.

Annual 1985 passenger revenues range from \$2,200,473 for Alignment 4 with options to \$1,244,712 for Alignment 2.

ENVIRONMENTAL, VISUAL, AND HISTORIC IMPACTS

The extent to which a DPM system could positively affect the environmental quality within the St. Louis CBD is dependent on the number of bus and auto trips which could be intercepted or eliminated before reaching the study area. If the system were designed to intercept vehicle trips before reaching the CBD, improvements in pollutant emissions, traffic congestions, traffic noise, exhaust odors, and the aesthetic quality would be realized. The improvements that could result from a DPM system are described below.

EMISSIONS

Current people mover technology relies on electrical energy as a means of propulsion. The emissions associated with this form of energy will be isolated to the location where the electrical power is generated. The City of St. Louis has two generating plants, both of which are located outside of the CBD. Because of their location, any negative impacts on the CBD will be negligible.

Positive impacts will result from the utilization of fringe parking lots by commuters and their diversion to the DPM for intra-CBD trips. Table 21 shows, the number of regional and internal auto trips which could be converted to DPM patronage.

Table 20
ST. LOUIS DPM FEASIBILITY STUDY
1985 ANNUAL DPM PASSENGER REVENUES^{1/}

	Alternative Alignments					
	<u>1</u>	<u>1A</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>4A</u>
Avg. Weekday Fare Passengers	22,100	22,900	16,800	17,500	25,700	29,700
Avg. Saturday Fare Passengers ^{2/}	12,155	12,595	9,240	9,625	14,135	16,335
Avg. Sunday and Holiday Fare Passengers ^{3/}	4,862	5,038	3,696	3,850	5,654	6,534
Annual Weekday Fares	\$1,408,875	1,459,875	1,071,000	1,115,625	1,638,375	1,893,375
Annual Saturday Fares	\$ 158,015	163,735	120,120	135,125	185,755	212,355
Annual Sunday Fares	\$ 70,499	73,051	53,594	55,825	81,983	94,743
Total Annual Passenger Revenue	\$1,637,389	1,696,661	1,244,712	1,296,575	1,904,113	2,200,473

^{1/} Does not include regional transit trips.

^{2/} 55 percent of average weekday DPM trips.

^{3/} 22 percent of average weekday DPM trips.

TABLE 21
ST. LOUIS DPM FEASIBILITY STUDY
AUTO TRIPS CONVERTED INTO DPM PATRONAGE

<u>Trip Type</u>	<u>Alternative Alignment</u>			
	<u>1 & 1A</u>	<u>2</u>	<u>3</u>	<u>4 & 4A</u>
Regional	15,100	10,600	12,100	16,700
Internal	800	600	700	800
TOTAL	15,900	11,200	12,800	17,500

Additional benefits will result from the minimization of Bi-State transit operations in the CBD. Table 22 displays the number of bus miles saved, if the local Bi-State routes were intercepted by the DPM.

TABLE 22
ST. LOUIS DPM FEASIBILITY STUDY
BUS MILES SAVED BY DPM INTERCEPT

<u>Time Period</u>	<u>Alternative Alignment</u>			
	<u>1 & 1A</u>	<u>2</u>	<u>3</u>	<u>4 & 4A</u>
Day	910	1,130	1,460	1,210
Year	232,050	288,150	372,300	308,550

By utilizing the auto trips and bus miles saved, it is estimated that a maximum of 3,175,900 vehicle miles of travel (VMT) would be saved by the DPM intercepting intra-CBD trips. This converts into 134.19 metric tons of pollutant burden not generated if Alignment 4 would be implemented. Table 23 displays the VMT and metric tons on pollutant burden saved by the various alternates.

TABLE 23
ST. LOUIS DPM FEASIBILITY STUDY
VMT/TONS OF POLLUTANT BURDEN SAVED PER YEAR

	Alternative Alignment			
	<u>1 & 1A</u>	<u>2</u>	<u>3</u>	<u>4 & 4A</u>
VMT	3,016,650	2,046,600	2,040,000	3,175,900
Metric Tons	126.85	87.34	106.15	134.19

ENERGY CONSUMPTION

As previously noted, the positive impacts of the St. Louis DPM are likely to be minimal unless intra-CBD trips are shifted from autos/bus to DPM. Electrical consumption by the DPM will vary by alternate and depend upon the rate assigned by Union Electric which provides electrical service to the City of St. Louis.

In order to provide some comparison, the energy operating requirements for U.S. rail, bus transit systems, and typical automobile are provided in Table 24. The figures show that the efficiency of the particular transportation mode is highly dependent on system utilization.

TABLE 24
ST. LOUIS DPM FEASIBILITY STUDY
SYSTEM ENERGY REQUIREMENTS

System	Vehicle Capacity (Seated & & Standing)	Kilowatt-Hrs. per Vehicle Mile	Kilowatt-Hrs. per Passenger-Mile (Capacity Load)
<u>Automated Guideway Systems</u>			
Vought	16 + 24 = 40	2.4	.060
Westinghouse	12 + 90 = 102	3.2	.031
Boeing	8 + 7 = 15	1.4	.093
<u>Other Modes</u>			
1. U.S. Rail Transit (National average)	75	6.1	.08
2. U.S. Bus Transit (National average)	50	3.5*	.07
3. Automobile (Assumes 20 miles per gallon)	4	0.6*	.15

*Assumes that one gallon of gasoline is equivalent in propulsion energy to 13.6 kwh of electrical energy.

Sources: ACT Systems - Nussbaum, E., and B. Zumwalt, Mirre Corporation, Environmental Impact Issues for Automated Guideway Transit Systems, 1976.

U.S. Transit Systems - American Public Transit Association, 1976-77 Transit Fact Book, 1977.

NOISE

The amount of noise generated by a DPM in St. Louis will be minimum and in comparison with the ambient noise levels in the CBD is insignificant. Noise generated by a DPM will be dependent upon the guideway location, the frequency of service, the hours of operation, the design specifications of the system, and the ambient noise level in the CBD at different times of the day.

The noise associated with the actual construction of the DPM may in itself be more critical than noise generated by the DPM. To minimize the effect of construction noise, the following measures should be considered in the contract plans and specifications:

- All engines and engine driver equipment used for hauling or construction shall be equipped with an adequate muffler in constant operation and properly maintained to prevent excessive or unusual noise.
- Construction within 1,000 feet of an occupied residence, motel, hospital or similar receptor shall be confined to the period beginning at 7 a.m. and ending at 10 p.m.

When final plans are prepared, the above restrictions on construction noises should be reviewed to determine if any situation has arisen which requires further consideration.

AESTHETIC QUALITY

All DPM alternative alignments will have visual impacts associated with the intrusion of the raised guideway on the existing infrastructure. Positive visual impacts will result from the decreased congestion of autos and buses on the downtown streets.

New vistas will be created for the DPM passenger. The city scope that they have been accustomed to will take on a new prospective, as passengers view buildings and open areas from 20 feet in the air. Alignments 1, 3, and 4 will yield scenic vistas as they cross the Gateway Mall at different points. Alignment 2 parallels to the Mall north of Tucker and will allow the DPM rider an extended vista along the mall.

HISTORIC

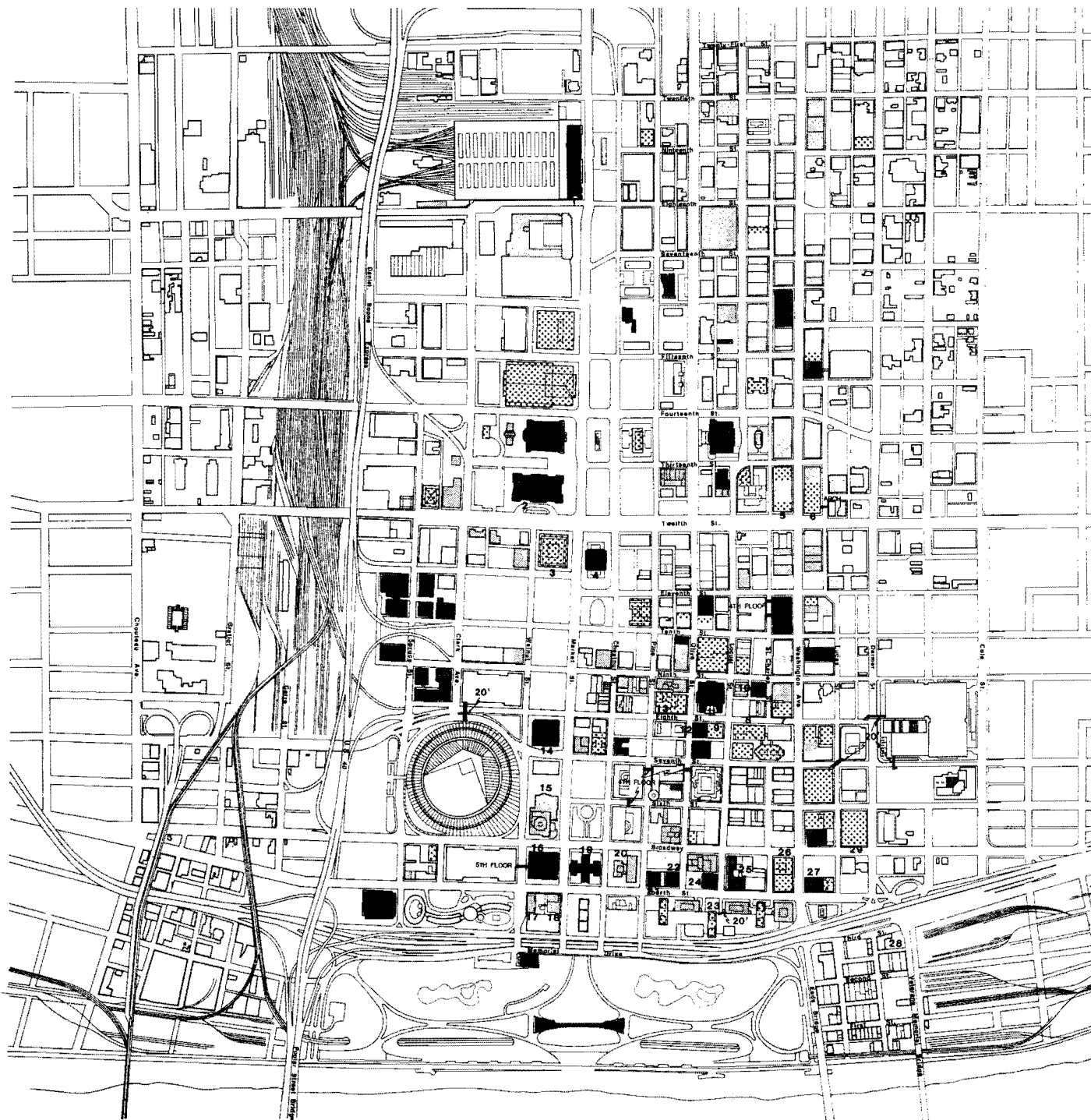
Many buildings, sites, and areas in the City of St. Louis have been determined to be architecturally and/or historically significant. Several sites are listed on the National Register of Historic Places. In order to place the alignment of the DPM and its stations so that they do not adversely affect the quality of these known sites, the Project Team in cooperation with the Landmarks Association of St. Louis, Inc. developed a list of sites within the DPM study area.

Each alternative alignment will be contiguous to numerous known sites. These sites are documented in Figure 33.

An archaeological survey has not been made of the alternate alignments. However, as part of the Environmental Impact Statement which must be prepared before implementation, an appropriate archaeological survey will be undertaken.

IMPACTS ON BUS SYSTEM

Implementation of a DPM system in the downtown St. Louis study area could lead to a substantial reduction in overall traffic volume in the area served by the DPM. One part of this reduction could be fewer numbers of buses on the CBD street system. This reduction in the number of buses would be accomplished by restructuring the existing bus routes to interface with the DPM system before those buses entered the CBD core or at the first location where the bus route crossed the DPM alignment. This would allow not only the



Downtown People Mover Feasibility Study

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Figure 33

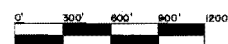
Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

Legend

- National Significance
- State Significance
- City Significance

- | | |
|-----------------------------------|--|
| 1. St. Louis Union Station | 16. Equitable Building |
| 2. St. Louis City Hall | 17. American Zinc, Lead and Smelting Company |
| 3. U.S. Court and Custom House | 18. International Fur Exchange Building |
| 4. Civil Courts Building | 19. Old Court House |
| 5. Silk Exchange | 20. Boatman's Tower |
| 6. Lesser-Goldman Building | 21. "4th and Pine" |
| 7. Lindell Building | 22. Merchants-Laclede Building |
| 8. Mercantile Trust Company | 23. Mansion House Center |
| 9. United Missouri Bank | 24. Security Building |
| 10. Mayfair Hotel | 25. Federal Reserve Bank |
| 11. Old Post Office | 26. Edison Brothers Store |
| 12. Chemical Building | 27. Missouri Athletic Club |
| 13. Arcade Building | 28. Laclede's Landing |
| 14. General American Headquarters | 29. Union Market |
| 15. Marriot Pavilion | |

ARCHITECTURAL/HISTORICAL SURVEY AND OVERHEAD STRUCTURES



reduction of the number of buses on the street system but also a reduction in overall miles and hours of travel for those buses. Both of these factors will influence overall bus operation costs.

In determining the changes that could be made to the bus routes, the Project Team evaluated only those routes which entered the CBD and took into account the desire on the part of Bi-State not to have any service degradation that could possibly result from the transportation mode change from bus to DPM. Because of this, it was determined that only the local bus routes should be examined for possible alterations, since changes in express bus routes would result in degradation of service to those passengers.

Initial evaluation of the local routes also indicated that all but one of the routes from Illinois should not be altered since they terminate, usually within a very short distance from one of the Mississippi River Bridges and changing to a DPM system for such a short distance would also result in a service degradation to those passengers.

The review of the local routes in Missouri which enter the CBD indicated that only one route should not be examined for a route change. This route was No. 40, Broadway, which travels through the downtown area, and as such, could not be, in effect, broken into two routes, north and south of the CBD. Through passengers would receive extremely degraded service if this was done. Therefore, the Broadway route was not included in the evaluation.

The above review resulted in an examination of twenty-two (22) local routes for changes in their routing resulting from a downtown DPM system. These routes are shown in Table 23.

The further examination of the bus routes in the table was done by altering the route to travel to the DPM station closest to the point at which the bus route either entered the CBD or intersected the DPM alignment. Those routes entering the downtown area from the west along Olive Street or any street further north were taken to the nearest DPM station along the loop parts of

Alignments 1 and 4, rather than to a station along the spur portion of these alignments along Clark Street from Tucker Boulevard to 18th Street.

TABLE 25
ST. LOUIS DPM FEASIBILITY STUDY
LOCAL DOWNTOWN BUS ROUTES REVIEWED
FOR DPM SYSTEM INDUCED ROUTE CHANGE

<u>Bus Route Number</u>	<u>Bus Route Name</u>
11	McPherson
15	Hodiamont
20	Cherokee
21	Tower Grove
30	Cass
32	Wellston-M.L.King, Jr.
41	Lee
52	Forest Park
73	Carondelet
74	Florissant
80	South Hampton
91	Olive
92	Lindenwood
93	Lindell
94	Page
96	Walnut Park
97	Delmar-Forsyth
99	Lafayette
104	Natural Bridge
105	Gravois
119	St. Louis Avenue
530	McKinley Bridge

Once the route was altered to serve the nearest DPM station, the total number of blocks saved or added by this alteration was determined for each candidate

alignment. These blocks were multiplied by the total number of bus trips made each weekday during the fifteen hours (15) the DPM operated (6:30 a.m.-9:30 p.m.) used for study purposes) and a total number of blocks saved by route and alignment was determined for each day. These totals were added to determine the total number of blocks saved by changing all 22 bus routes for each alignment. These results are shown in Table 24.

It must be noted here, that these savings could be considered the maximum possible for local routes. Should Bi-State adopt a policy that would differ from one in agreement with these analysis assumption, then the blocks and subsequent cost savings would be different.

After the total number of blocks saved per day was determined the yearly cost savings were calculated using the following data supplied by Bi-State:

- Weekdays of operation per year: 255
- Average speed of buses in CBD: 8 mph
- Typical length of city block: 300 feet
- Maintenance cost per mile: \$0.2834
- Labor cost per hour: \$15.0247

Utilizing this data, the cost savings calculated for each alignment is shown in Table 24.

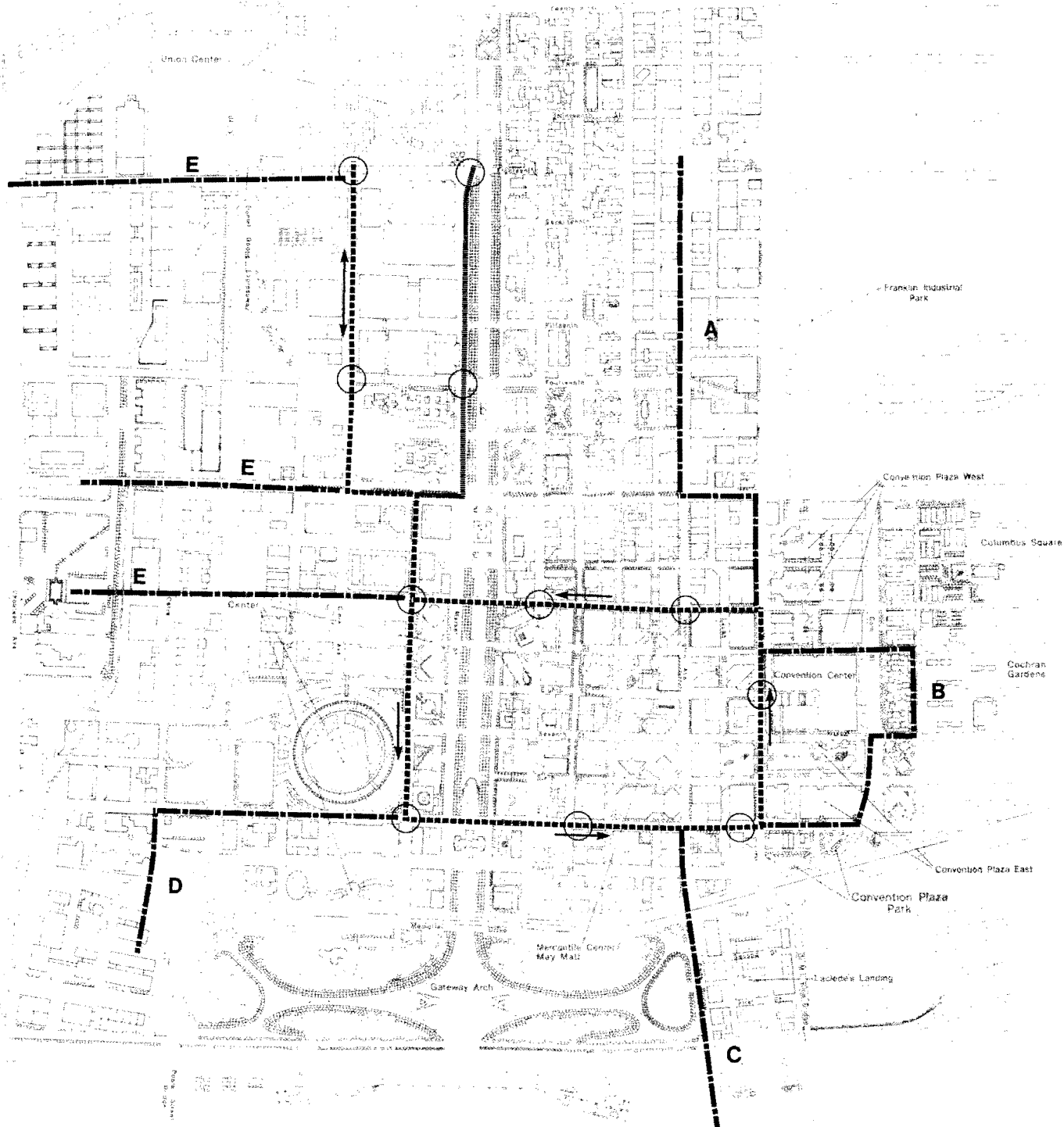
TABLE 26
ST. LOUIS DPM FEASIBILITY STUDY
ANNUAL COST SAVINGS FOR WEEKDAY OPERATION
OF LOCAL BUS ROUTES IN DOWNTOWN ST. LOUIS

<u>Alignment</u>	<u>Annual Cost Savings</u>
1 & 1A	\$503,600
2	624,100
3	807,200
4 & 4A	669,500

As noted previously, these savings are only for local bus route weekday operation and are contingent on policies developed by Bi-State in terms of the extent of bus route penetration of the CBD and whether or not express routes would also be altered on those passengers transferred to the DPM.

EXPANSION POTENTIAL

The candidate alignments being discussed in this Chapter all have potential for expansion (see Figures 34-37). Alignments 1, 1A, 4, and 4A have the greatest expansion potential with seven and five extensions, respectively. Alignments 2 and 3, being shuttles rather than loops, are more limited in their expansion capabilities. All alternatives could be extended to serve the East St. Louis area.



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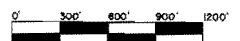
Figure 34

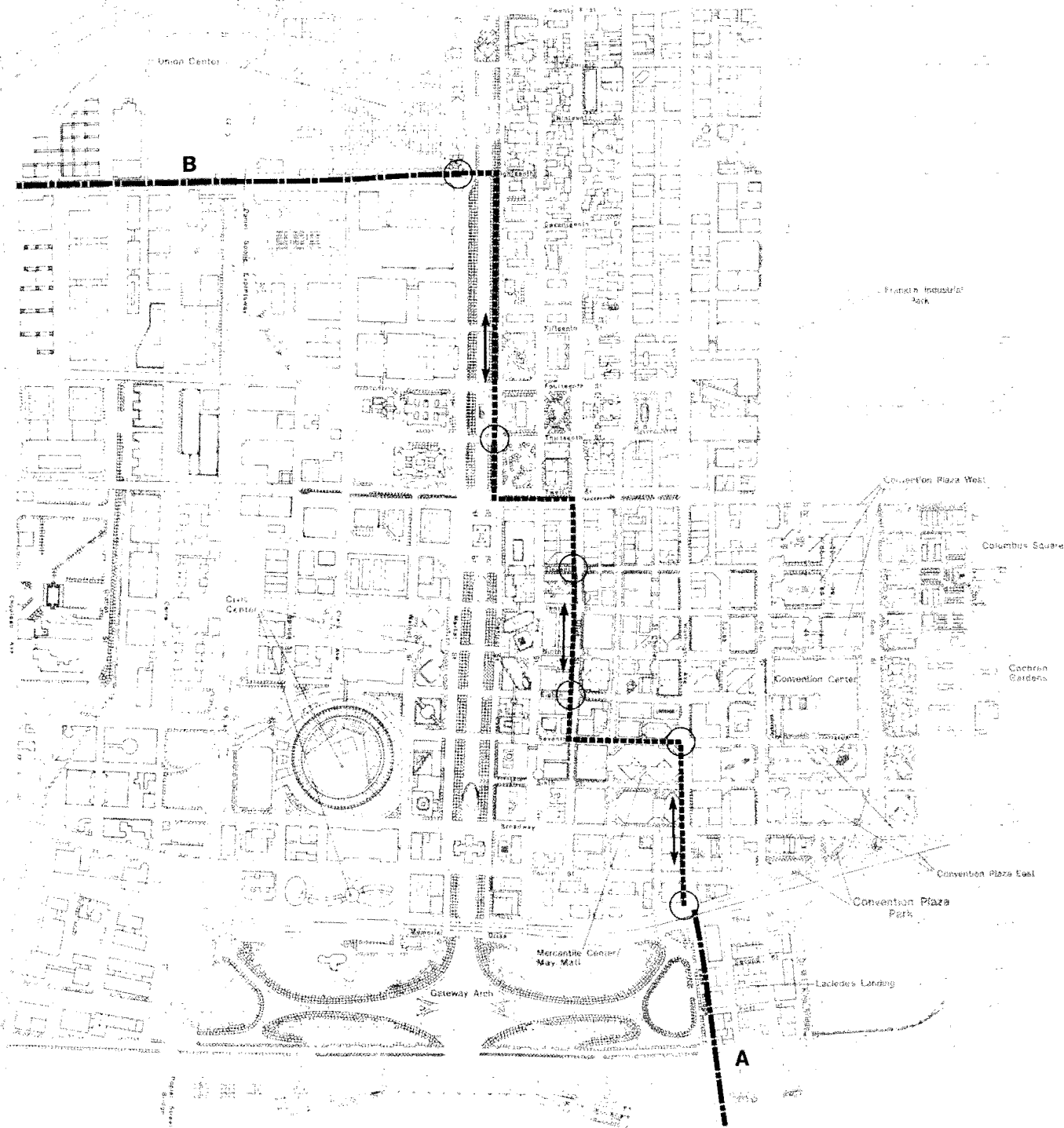
Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

Legend

- Station
- Direction of Travel
- Primary Route
- Optional Route
- Alignment Expansion

ALTERNATIVE ALIGNMENT 1 EXPANSION POTENTIAL





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Figure 35

Legend

-  Station
-  Direction of Travel
-  Primary Route
-  Alignment Expansion

ALTERNATIVE ALIGNMENT 2 EXPANSION POTENTIAL



Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri



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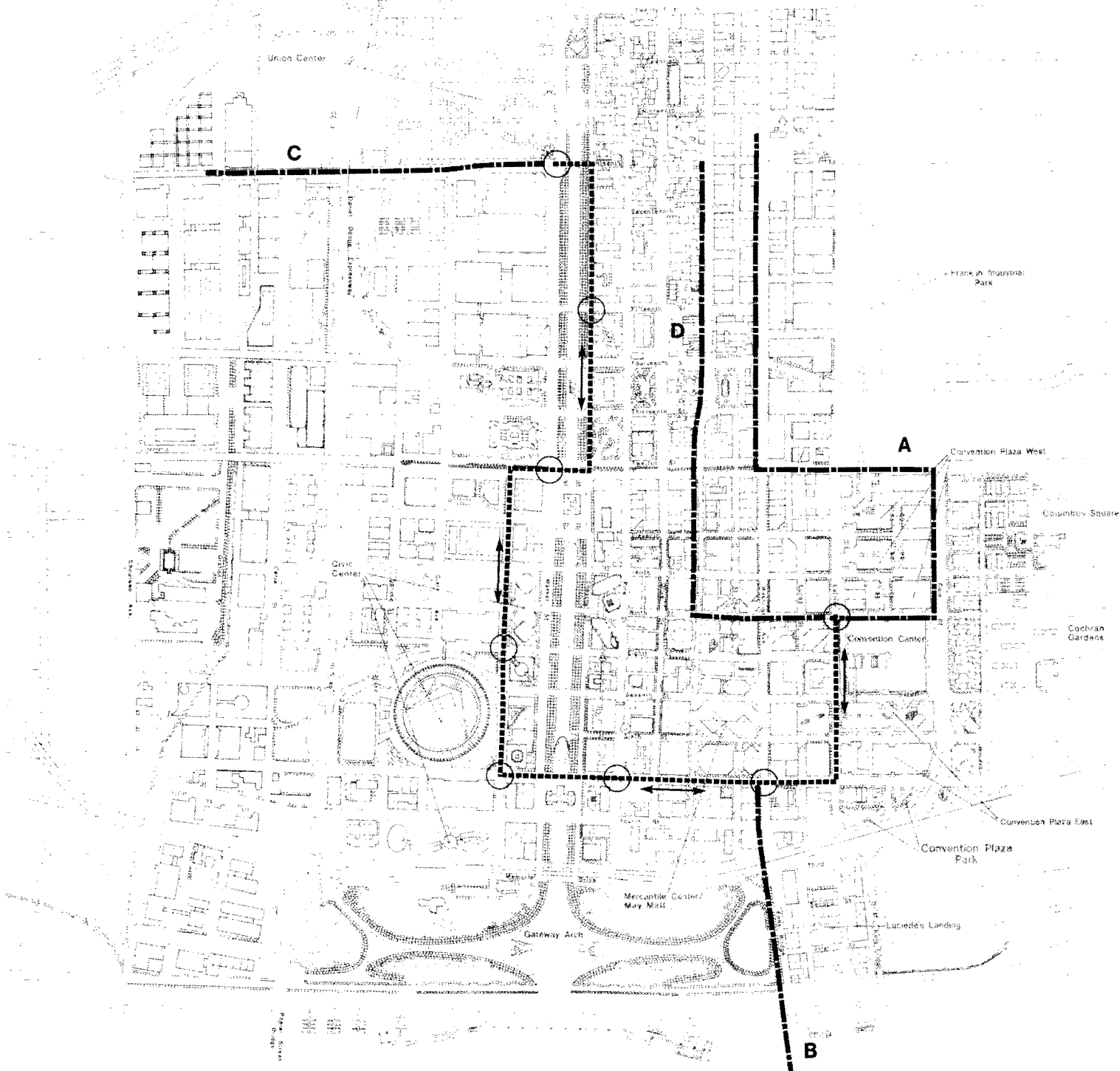
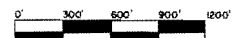
Figure 36

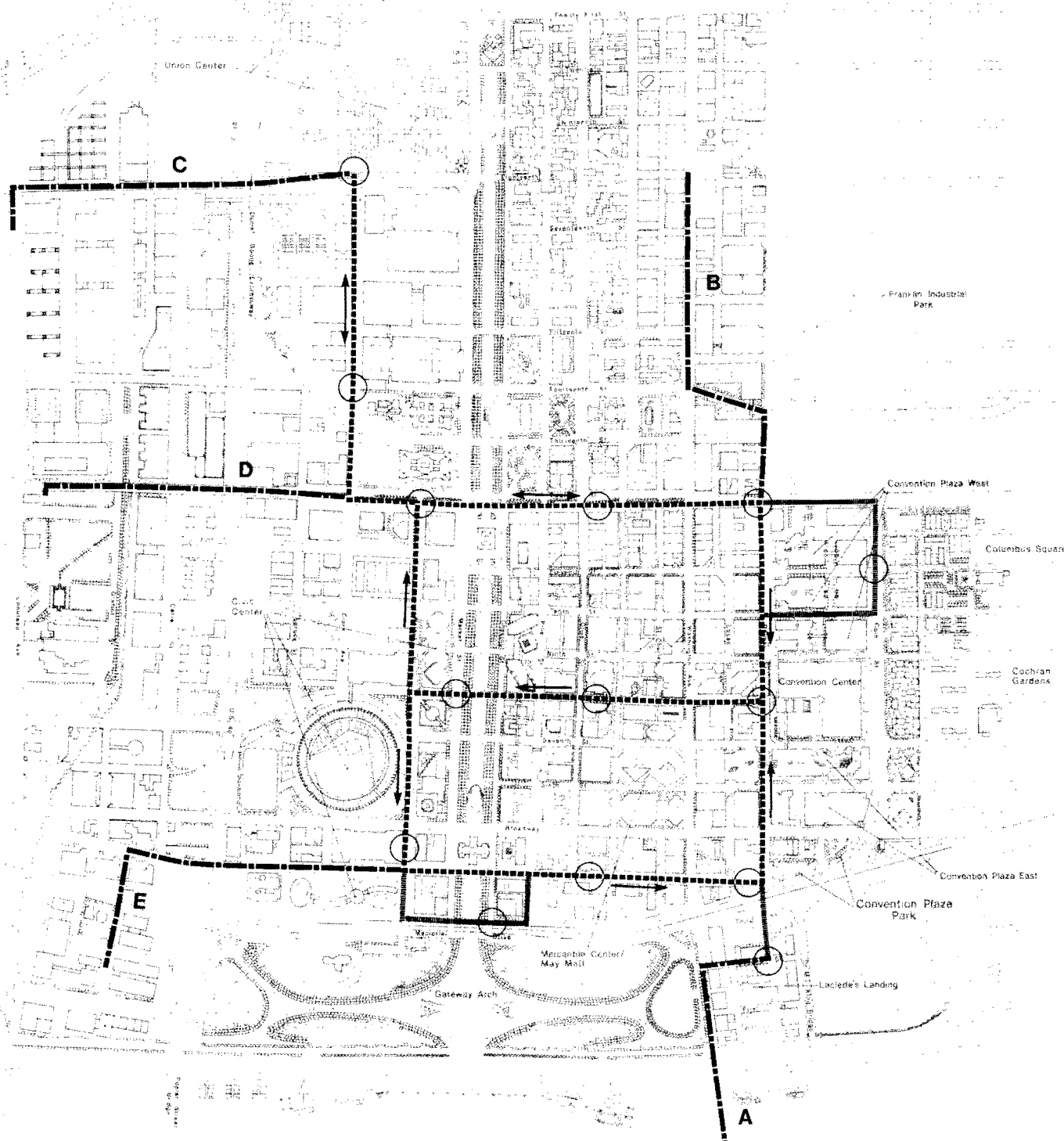
Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

Legend

-  Station
-  Direction of Travel
-  Primary Route
-  Alignment Expansion

ALTERNATIVE ALIGNMENT 3 EXPANSION POTENTIAL





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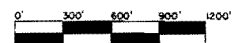
Figure 37

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

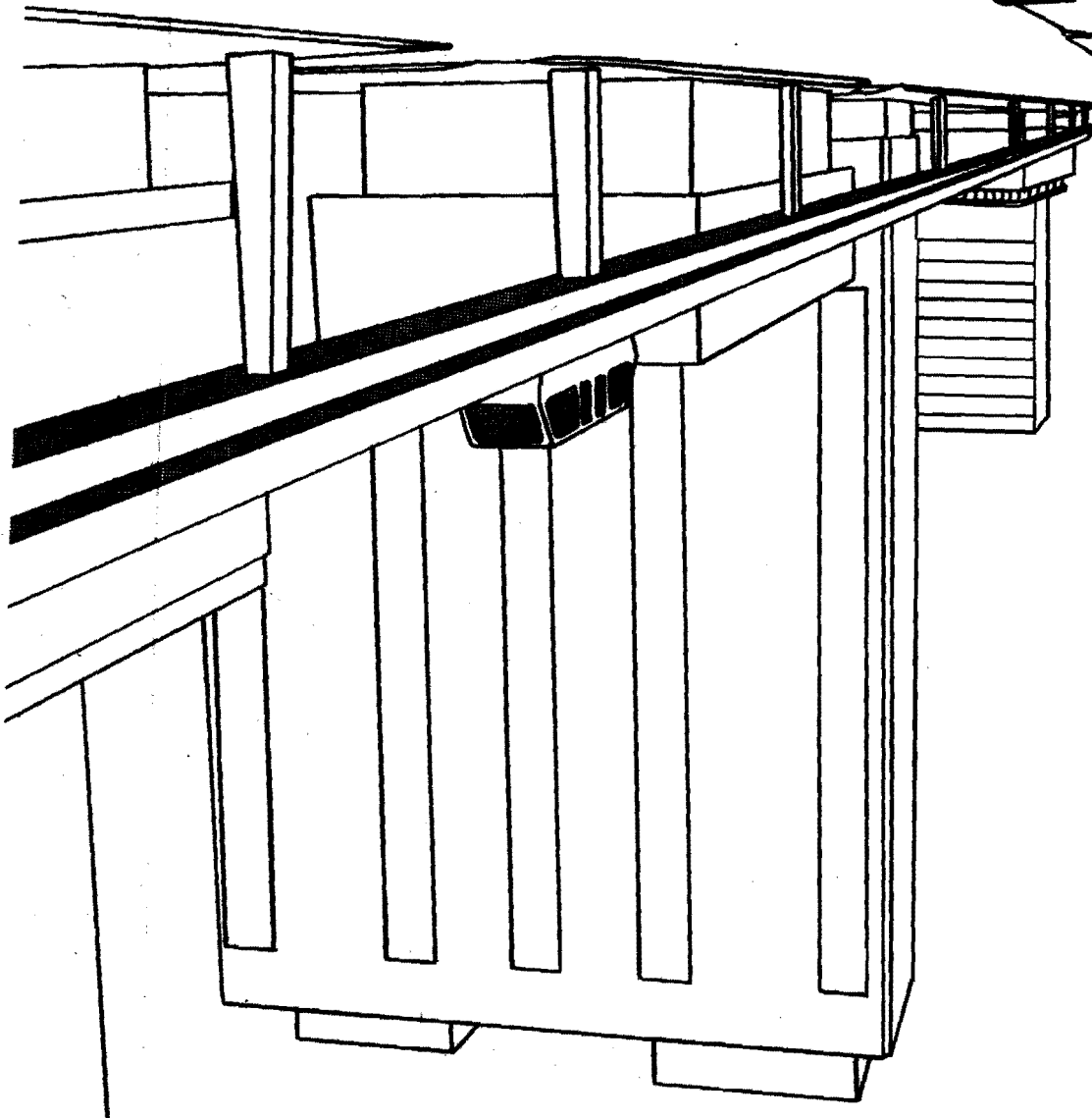
Legend

- Station
- Direction of Travel
- Primary Route
- Optional Route
- Alignment Expansion

ALTERNATIVE ALIGNMENT 4
EXPANSION POTENTIAL



V. EVALUATION AND SELECTION OF RECOMMENDED ALIGNMENT



V. EVALUATION AND SELECTION OF RECOMMENDED ALIGNMENT

TRADE-OFFS AMONG ALTERNATIVE ALIGNMENTS

The characteristics, impacts and attributes of the four major candidate alignments are described in the previous chapter. Examination of these data indicates that none of the four alignments is totally dominant in the analytic sense (i.e., each of the candidates "performs" best on at least one dimension). For example, Alignment 2 has the lowest initial capital cost, Alignment 4A has the highest patronage, Alignment 3 yields the fewest adverse environmental impacts, etc. A summary comparison of key characteristics for the alternatives is provided in Table 25.

This chapter describes the analytic procedures used to compare the alignments and assess their relative merits with respect to the weighted goals and objectives which emerged from the Technical Review Committee.

RELATIONSHIP TO GOALS AND OBJECTIVES

The procedure used to compare alternatives consisted of a six-step process:

- Step 1 - Define direct or surrogate measures of effectiveness (MOE's) for the several goals and key objectives under each.
- Step 2 - Assign a score (quantitative measure or rating) to each alternative with respect to each MOE.
- Step 3 - Sum the MOE's for each objective and multiply these totals by the weight assigned to that objective by the Technical Review Committee.
- Step 4 - Normalize the results from Step 3 to yield a score of 0-1.0 for each alternative on each objective (normalization involves assigning a value of 1.0 to the highest alternative and

TABLE 27
ST. LOUIS DPM FEASIBILITY STUDY
SUMMARY COMPARISON OF ALTERNATIVES

CHARACTERISTICS	ALIGNMENT ALTERNATIVES				
	1	2	3	4	4A
Guideway Length (lane feet)	17,100	15,800	20,900	20,200	23,500
Route Length (feet)	13,000	7,900	10,450	17,400	21,000
Configuration	core loop w/shuttle	two-way core shuttle	two-way perimeter shuttle	one-way Figure 8 w/shuttle	one-way Figure 8 w/shuttle
No. of Stations	9	6	8	11	13
Total Travel Time (Round Trip) ¹	19.4 min.	18 min.	24.1 min.	17.1 min. ² 27.1 min.	19.2 min. ² 31.2 min.
Avg. Weekday 1985 Patronage (\$.25 fare)	40,800	31,500	33,800	46,700	50,700
Annual Weekday Revenue	\$1,637,389	\$1,244,712	\$1,296,575	\$1,904,113	\$2,200,473
% CBD Employment Served (1985)	82%	69%	71%	95%	98%
CBD Retail Floor Space Served (in millions of sq. ft.)	3.075 (87%)	2.970 (84%)	2.435 (69%)	3.480 (97%)	3.500 (98%)
# of Class A CBD Hotel Rooms Served	6,300 (100%)	2,800 (44%)	5,350 (85%)	6,300 (100%)	6,300 (100%)
# of Spaces in Parking Structures Served	19,000	12,000	18,250	20,700	20,700
# of Station Areas With Above Avg. Long-term Joint Development Potential	6	5	6	7	8
Est. Construction Costs (Millions), 1980 ³	\$58.9	\$50.6	\$67.3	\$70.1	\$72.4
O & M Costs per year (Millions) ⁶	\$1.7 - \$2.4	\$1.5 - \$1.9	\$1.6 - \$2.0	\$2.3 - \$2.8	\$2.4 - \$3.0
Bus Operations Savings per Year ⁴	\$503,500	\$624,000	\$807,200	\$669,500	\$669,500
Pollutant Burden Saved per Year (Metric Tons)	127	87	106	134	134

¹Based on maximum cruising speed of 20 mph and an average of 1600 feet between stations

²West Loop only

³The following cost items are not included:

- Right-of-Way Acquisition
- Street and ROW Improvements

⁴Includes only local bus routes terminating downtown and assumes 255 operating days per year

⁶Based on historical data from other cities, costs will range from \$0.16 to \$0.20 per passenger.

proportional values between 0 and 1.0 to the remaining alternatives).

Step 5 - Aggregate the weighted normalized values for each alternative into scores on each of the six goal areas.

Step 6 - Derive a composite score for each alternative based on the relative importance of each goal area, as defined by the responses of the Technical Review Committee.

The MOE's used to evaluate each goal area consisted of the following:

Economic Development

- Percent 1985 CBD office employment in 600 foot walkshed
- Percent 1985 CBD retail space in 600 foot walkshed
- Percent 1985 CBD hotel rooms in 600 foot walkshed
- Square footage 1985 tourism/convention/visitor-oriented space in 600 foot walkshed
- Qualitative assessment of linkages among retail/office/hotel convention space

Land Use and Transit-Related Joint Development

- Number of station areas with excellent or good joint development potential (judgment based on composite of land availability, market factors, physical proximity, potential for station integration, and site development plans).

CBD Environmental Quality

- Air Quality - net reduction in vehicle-miles of travel in CBD (bus and auto based on reduction in CBD bus operations and patronage diverted from auto).
- Noise - number, proximity and nature of noise sensitive land uses in vicinity of guideway.
- Historical - number of designated historical sites fronting on guideway.
- Construction impacts - assessment based on width of streets, vertical obstructions, utility lines, and number of street-level establishments or parking facility entrances along guideway.
- Aesthetic - judgment based on proximity to significant streetscapes, architectural features, views and vistas.

CBD Transportation

- Average daily patronage
- Percent of patrons diverted from auto use
- Route-miles of bus service replaced by DPM
- Number of spaces in CBD parking structures served by DPM
- Number of spaces in existing/potential interceptor parking facilities
- Number of bus routes intersected

System Cost and Cost-Effectiveness

- Estimated system construction cost - total and per rider
- Estimated DPM annual operating and maintenance costs - total and per rider
- Net savings in bus operating and maintenance costs with DPM

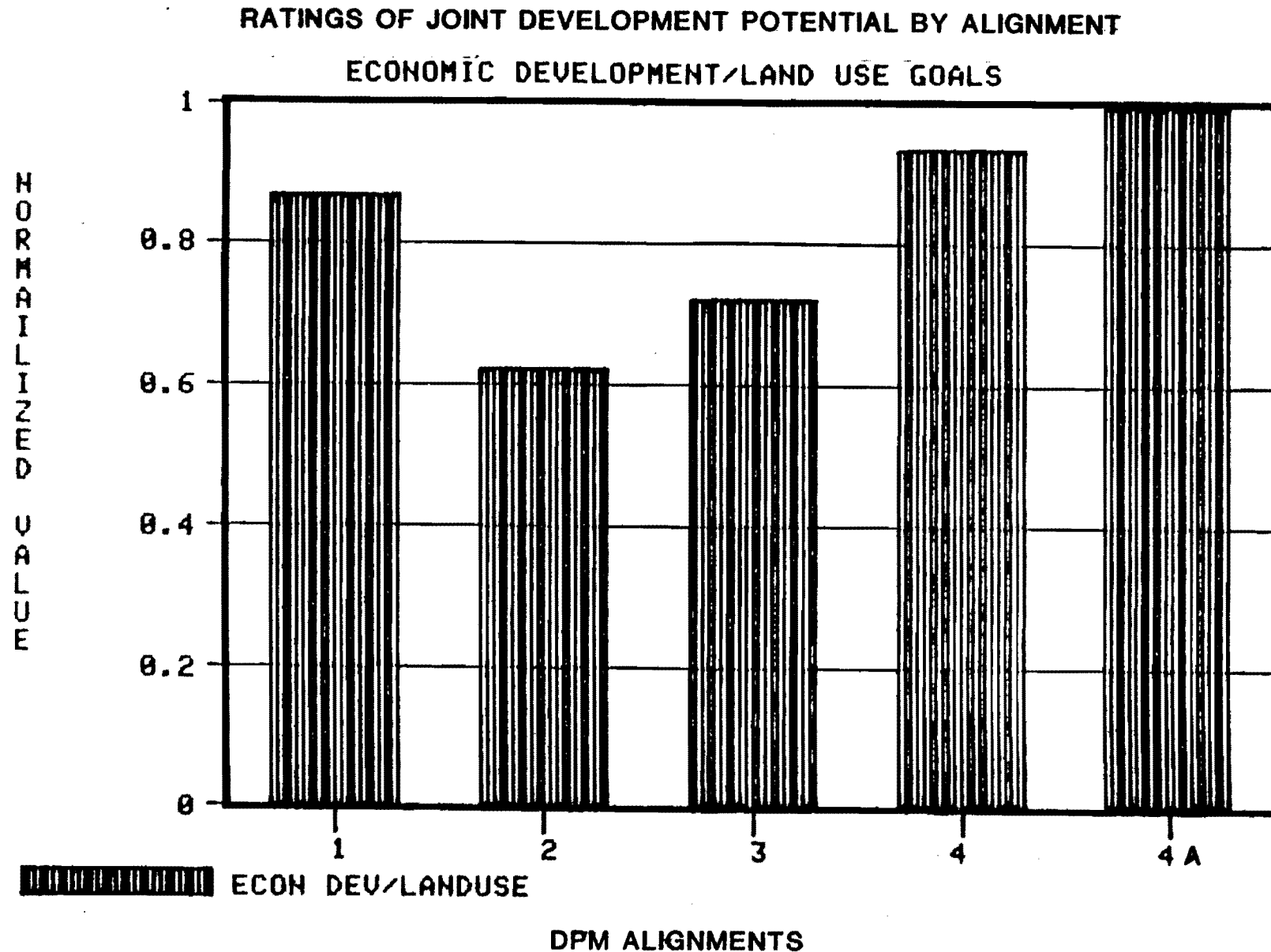
Social Impact

- Square footage and number of public facilities and institutions in 600 foot walkshed
- Relative proportion of elderly, minority and/or low income residents in walkshed
- Judgment of neighborhood impacts or disruption

The aggregate comparative and normalized values obtained from application and normalization of the MOE scores in each goal area shown in Figure 38 through 43. In each figure, the highest scoring alternative is assigned a value of 1.0 and the others are valued on the basis of the percentage of this highest score that they attained. This procedure provides for greater discrimination than a simple ranking since it also considers the relative size of the differences. A simple ranking does not distinguish between Alignment 1, 4 and 4A, but indicates the inferiority of Alignment 2. The use of normalized scores yields the following ordering of the alignments:

Figure 38

St. Louis DPM Feasibility Study



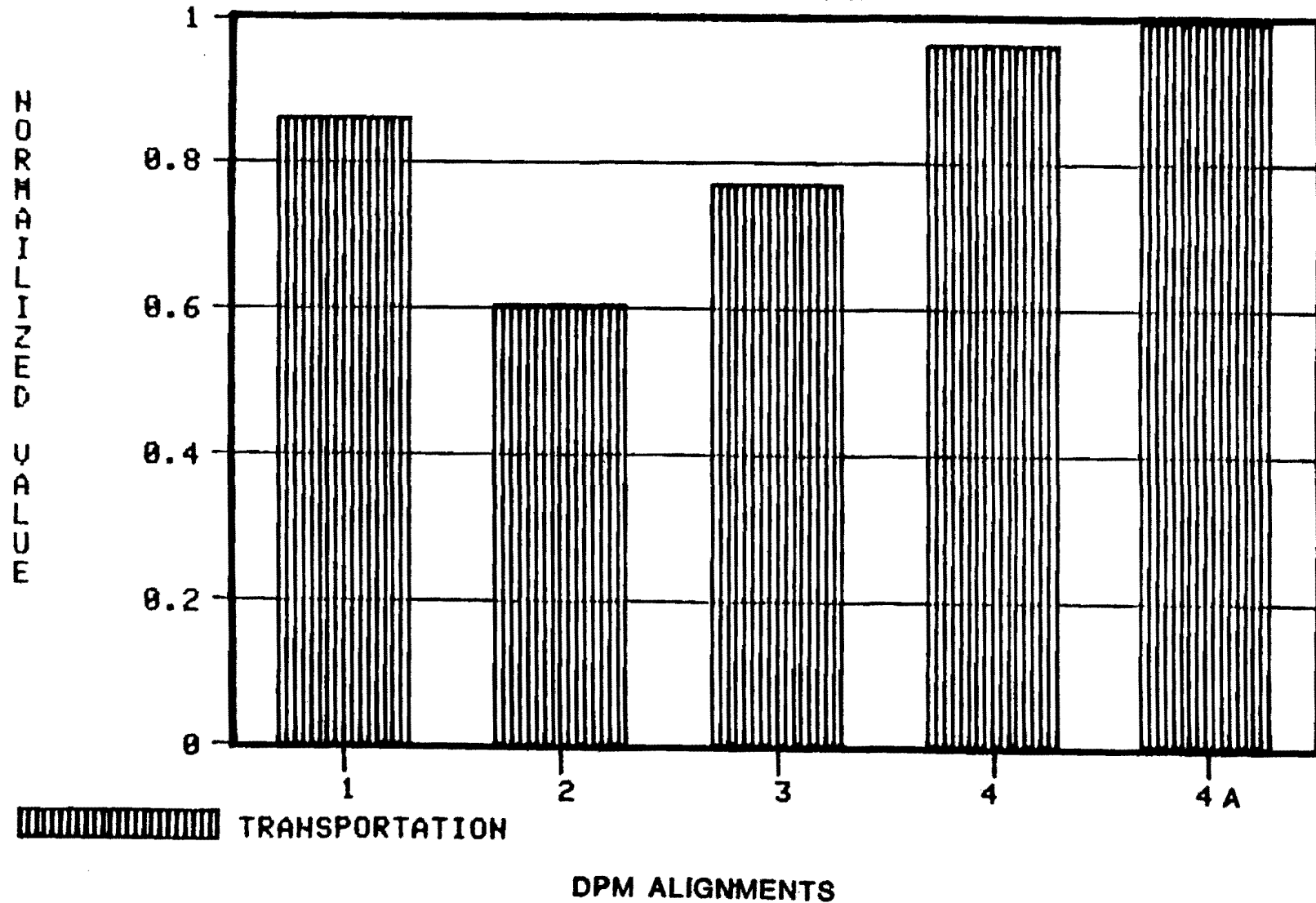
SOURCE: Robert J. Harmon and Associates, Inc.

Figure 39

St. Louis DPM Feasibility Study

RATINGS OF JOINT DEVELOPMENT POTENTIAL BY ALIGNMENT

TRANSPORTATION GOALS

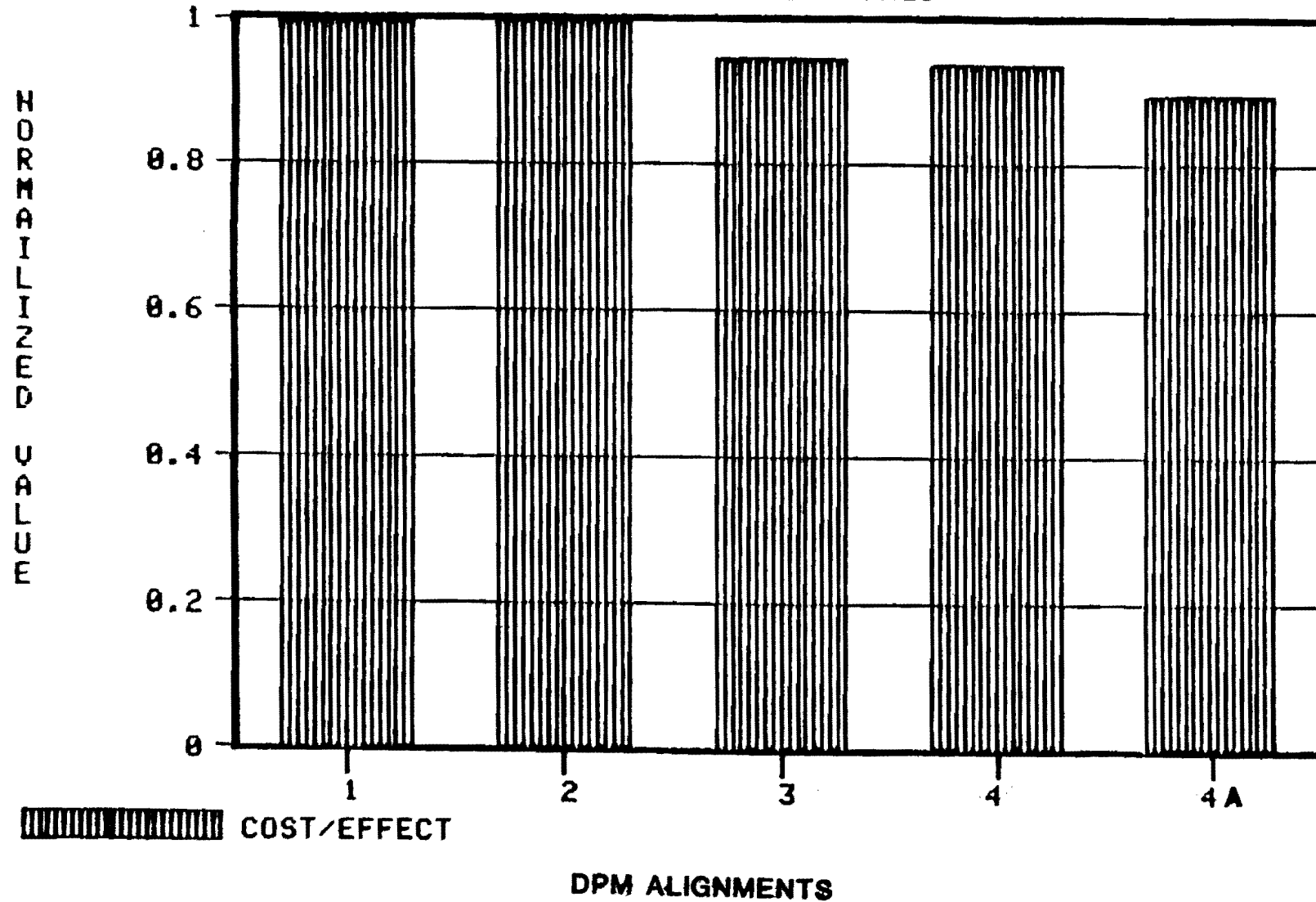


SOURCE: Robert J. Harmon and Associates, Inc.

Figure 40

St. Louis DPM Feasibility Study

RATINGS OF JOINT DEVELOPMENT POTENTIAL BY ALIGNMENT
COST/EFFECTIVENESS GOALS



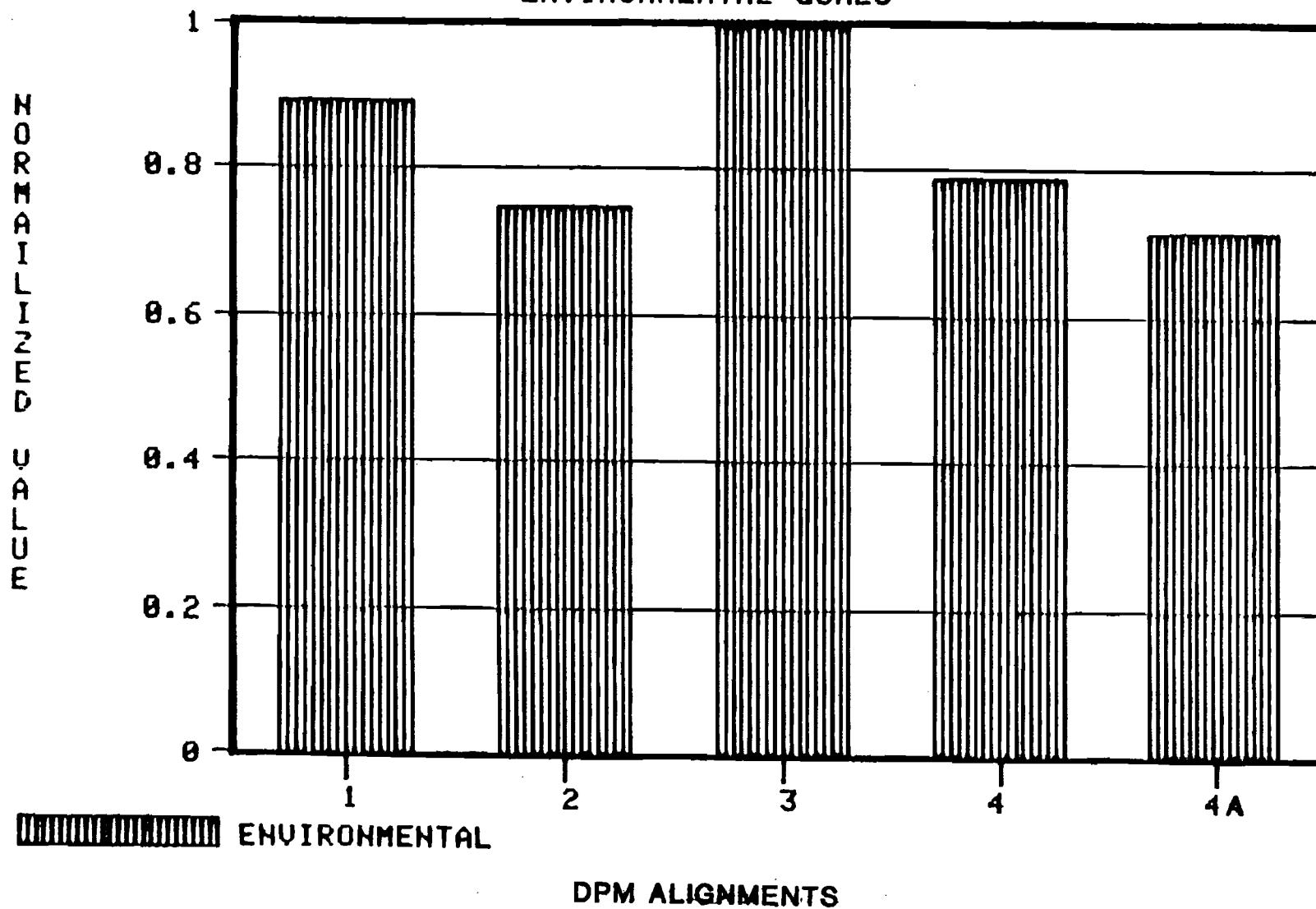
SOURCE: Robert J. Harmon and Associates, Inc.

Figure 41

St. Louis DPM Feasibility Study

RATINGS OF JOINT DEVELOPMENT POTENTIAL BY ALIGNMENT

ENVIRONMENTAL GOALS

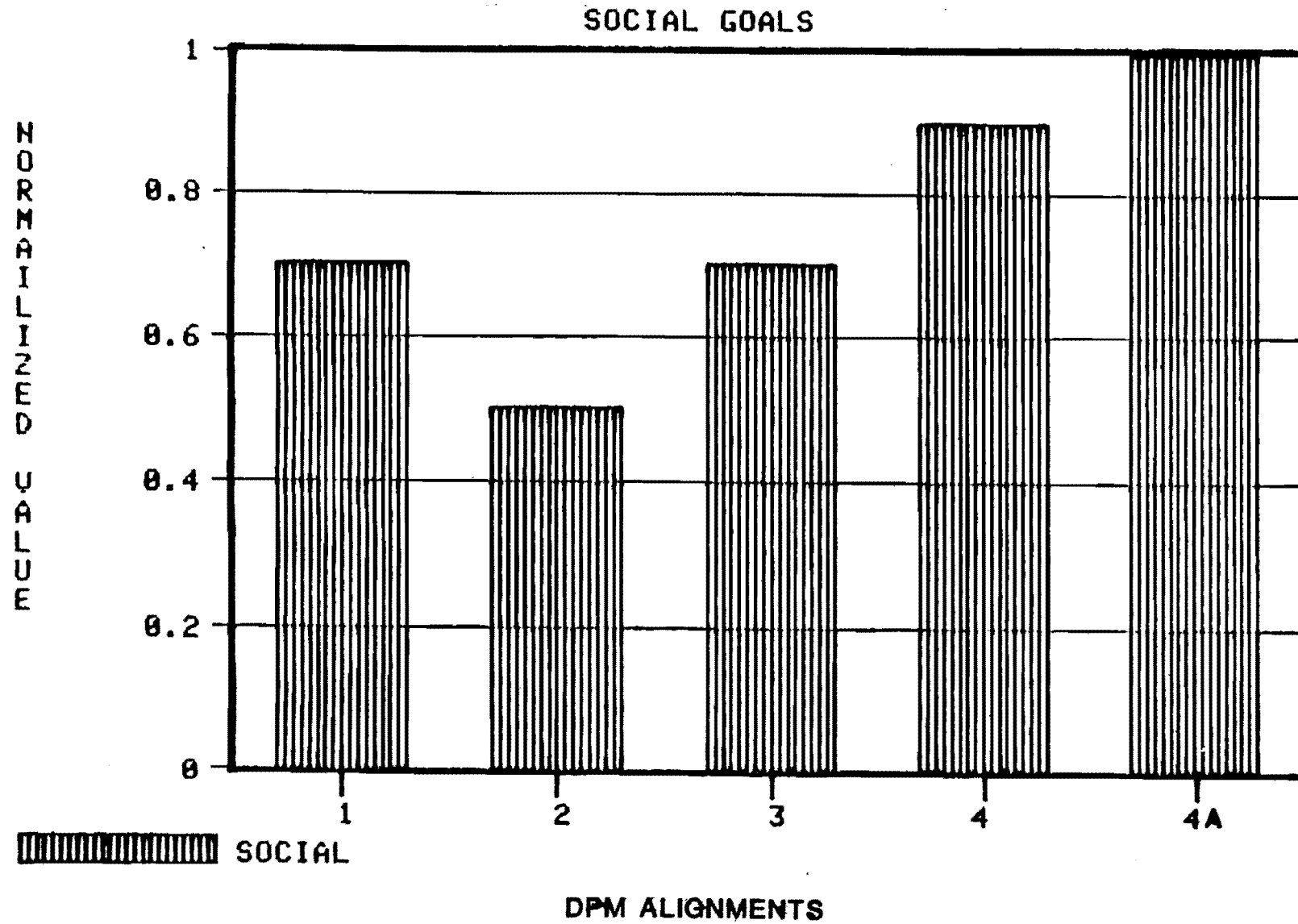


SOURCE: Robert J. Harmon and Associates, Inc.

Figure 42

St. Louis DPM Feasibility Study

RATINGS OF JOINT DEVELOPMENT POTENTIAL BY ALIGNMENT



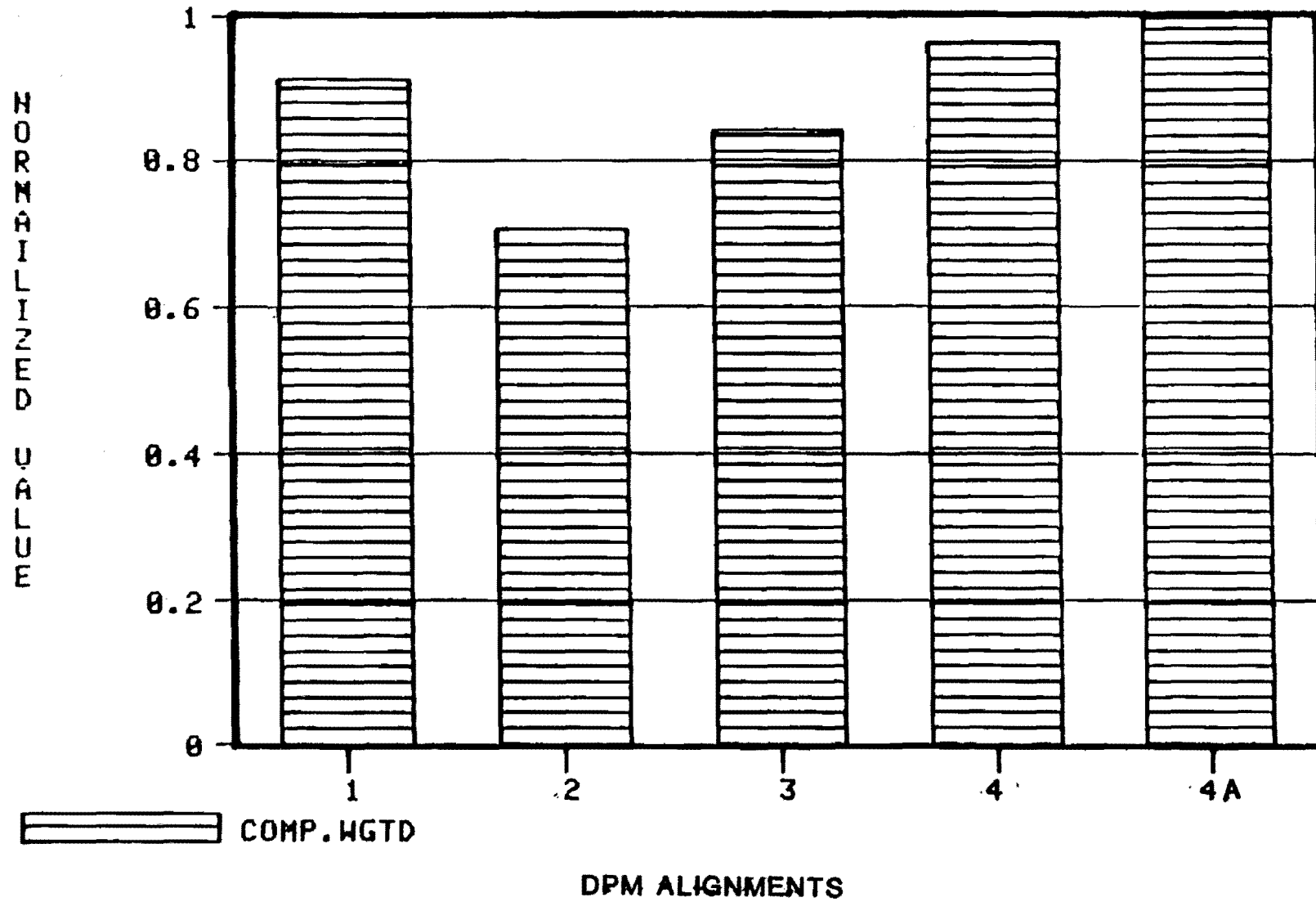
SOURCE: Robert J. Harmon and Associates, Inc.

Figure 43

St. Louis DPM Feasibility Study

RATINGS OF JOINT DEVELOPMENT POTENTIAL BY ALIGNMENT

COMPOSITE WEIGHTED VALUES



SOURCE: Robert J. Harmon and Associates, Inc.

<u>Alignment</u>	<u>Total Score</u>
4A	4.62
4	4.51
1	4.36
3	4.11
2	3.47

The most pertinent measure of the relative merits of the options involves the application of the derived weights for each goal to the normalized scores. This composite evaluation is indicated below:

<u>Goal Area</u>	<u>Normalized Weighting</u>	<u>Weighted Score</u>				
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>4A</u>
Economic Development	1.00	.88	.62	.70	.92	1.00
Land Use/Joint Development	.99	.87	.61	.69	.91	.99
Environmental Quality	.69	.62	.52	.69	.54	.50
Transportation	.84	.74	.50	.64	.81	.84
System Cost-Effectiveness	.61	.61	.58	.58	.58	.55
Social Impacts	<u>.66</u>	<u>.46</u>	<u>.33</u>	<u>.46</u>	<u>.59</u>	<u>.66</u>
Total Weighted Score		4.18	3.19	3.76	4.35	4.54
Normalized Value		.92	.70	.83	.96	1.00

These data indicate that application of the goal weights derived from ratings by members of the Technical Review Committee does not change the ranking of alternatives. Alignments 4 and 4A rank the highest and Alignment 2 ranks the lowest. Nevertheless, the weighted normalized values calculated above and shown graphically in Figure 43 provide the single best composite indicator of the relative merit of each candidate alignment.

Design Process

The Project Team presented the trade-off analysis and the above computations of relative merit to the Technical Review Committee at the June 23, 1980 meeting. Based on these findings and related discussions, the Committee eliminated Alternatives 2 and 3 from further consideration and requested further study of a variation of Alternative 1, specifically the re-location of the eastern segment from Broadway to Fourth Street.

At a review of the Technical Review Committee on July 1, 1980, the Project Team provided additional data on Alignment 1A (800 added daily riders, \$2 million in additional costs, and two additional stations with excellent long-term development potential). The relative merit of Alternative 1A per each of the six goal areas is equivalent to Alternative 1.

After further discussion, the Committee selected Alignment 4 as the most desirable option and directed the Project Team to develop a more detailed and refined analysis of this alternative (including each of the three loop options, Alignment 4A, to the Gateway Arch, Laclede's Landing, and Cole Street Alignment, 4A) during the remainder of the Phase I effort. Chapter VI documents the refined analysis of Alignments 4 and 4A.

BUS-ONLY ALTERNATIVE

The Bus Only Alternative was developed to compare the recommended alternative DPM alignment with a bus only system. In order to compare the Bus Only Alternative to the DPM system, the same transportation service and ridership needs were established for both systems. Bus headways were established equivalent to those of the recommended DPM system.

The extensive use of one way streets in the study area required some modification to the DPM route. The Bus Only Alternative alignment is shown on Figure 44. Market Street was used as the southern link for the Bus Only Alternative between 8th and Tucker Boulevard. The northwest portion of the

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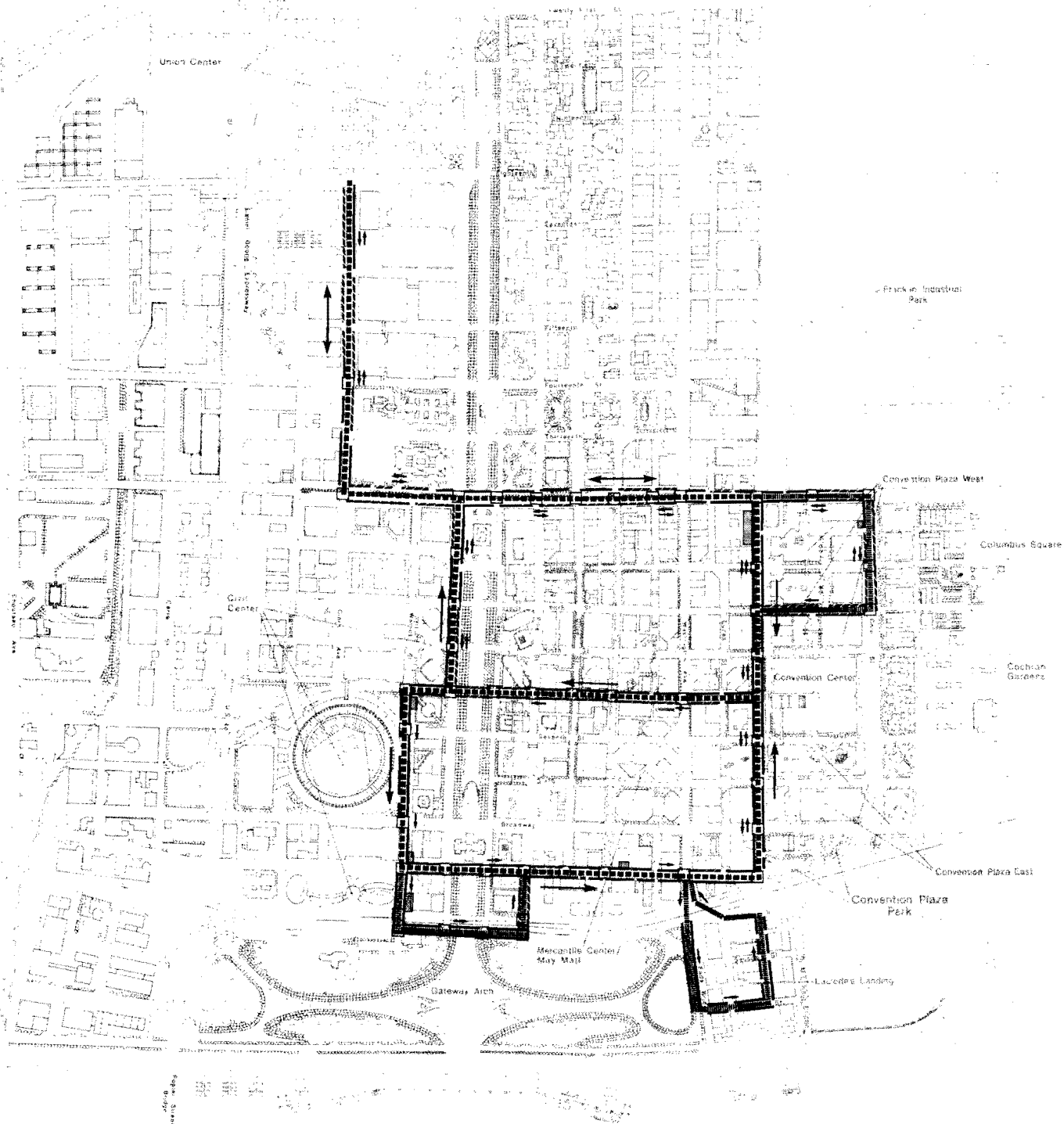
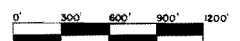
Booker / Bernard Johnson

Figure 44

Base Map Courtesy of:
Community Development Agency
St. Louis, Missouri

- Legend**
- Bus-Only-Option Route
 - Direction of Traffic Flow
 - Traffic Signal
 - Parking
 - No Parking
 - Reserved or Restricted Parking
 - ▨ Special Delivery Area
 - ↔ Direction of Bus Option

BUS ONLY OPTION



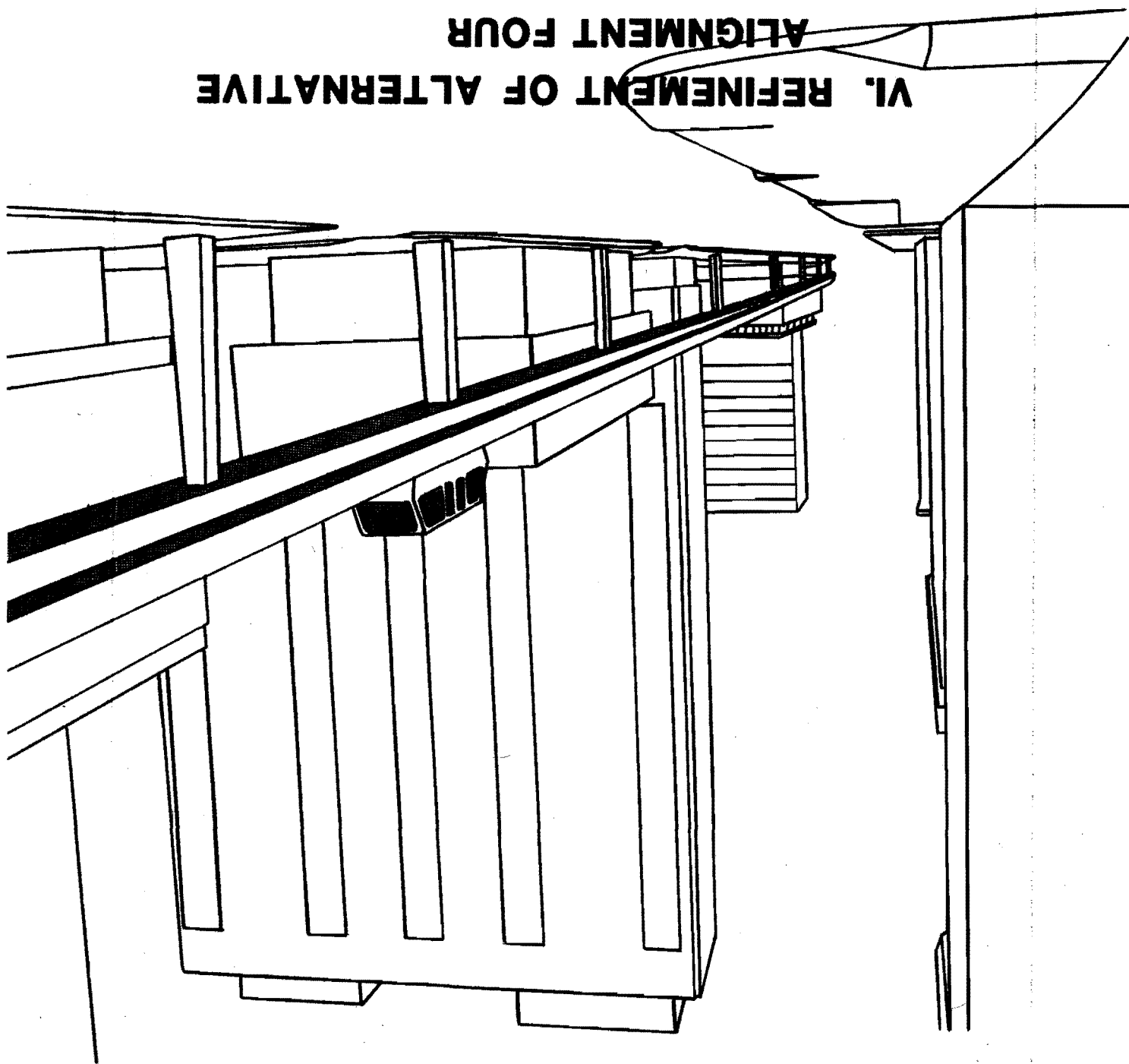
bus system was extended southbound to 10th Street to utilize the existing street system.

The Bus Only Alternative serves the same area as the recommended DPM alignment. Within the three minute walk sheds of the bus routes the same employment and resident population is served. However, no measurable value capture or joint development potential can be produced by the Bus Only Alternative.

The Bus Only Alternative has significant environment impacts upon the study area. It increases the automobile and transit volumes, emissions, and noise in the downtown area. The use of a "pre-empt" computerized signal system to avoid delays for the buses at signalized intersections will cause queues of auto, trucks and other buses on the cross streets. Standing vehicles will also have a major impact on the visual quality of the area.

The Bus Only Alternative will cost approximately \$2,600,000 a year (1980 dollars) for operation and maintenance. The majority of this expense is incurred in the labor category. The capital cost for the Bus Only Alternative is estimated at \$33,500,000 1980 dollars. A major item in this cost is for replacement of the transit vehicles at the end of their 10 year life. Two cycles of bus replacements are required for comparison to DPM vehicle replacement. The Bus Only Methodology and costs are described in Appendix C.

**VI. REFINEMENT OF ALTERNATIVE
ALIGNMENT FOUR**



VI. REFINEMENT OF ALTERNATIVE ALIGNMENT FOUR

ENGINEERING, GUIDEWAY, AND SYSTEMS

Alignment 4 has a basic route with three options (see Figure 25). The basic alignment of Alignment 4 is a single-lane figure eight core loop with a two-way dual-lane shuttle. The two-way shuttle begins at Union Center and ends at the southwest corner of the figure 8 loop. The west loop of the figure 8 is located on Tucker Boulevard to the west, Convention Plaza to the north, 8th Street to the east and Walnut Street to the south. The east loop of the figure "8" is located on 8th Street to the west, Convention Plaza to the north, 4th Street on the east and Walnut Street to the south.

The three options are the Memorial Drive loop, the Laclede's Landing shuttle and the Columbus Square loop. The Memorial Drive loop moves the DPM alignment from 4th Street east one block near Memorial Drive between Walnut Street and Pine Street. At Pine Street the guideway continues north on 4th Street. This loop adds 400 feet of guideway on Walnut Street and 400 feet of guideway on Pine Street, for a total of 800 feet additional guideway. One additional station is required for this option.

The Laclede's Landing option adds 500 feet of dual-lane guideway to the basic route (1000 feet total). This dual-lane shuttle is elevated and would use long-span beams to cross the Memorial Drive overpass. The station at 4th Street would be relocated to the east end of the Laclede's Landing shuttle. The Laclede's Landing option would require two additional switches to allow vehicles to either continue around the east loop or to enter the south lane of the Laclede's Landing shuttle. Vehicles that enter the shuttle would return to the east loop after being transferred to the north lane of the shuttle. This transfer would take place at the Laclede's Landing station.

The third option is located near the Columbus Square. This option moves Alignment 4 from Convention Plaza to Cole Street between 10th Street and Tucker Boulevard. This adds 900 feet of single-lane guideway on 10th Street

and 900 feet on Tucker Boulevard, for an additional 1800 feet of guideway. One station would be added to this option at 11th and Cole Streets.

The Columbus Square and Memorial Drive options do not have significant changes in the base route. Both options use the same standard structural components (beams, columns, footings) as the base route. The Laclede's Landing option would require some modification in the base route and the use of non-standard structural components to cross the Memorial Drive overpass.

The profile of Alignment 4 is shown in Figure 45 and 46. This figure shows the profile of the dual-lane shuttle, the west loop, the east loop and the Laclede's Landing alternate. The base route profile has a maximum grade of less than 2 percent. This is well within the maximum grade requirements of the eligible DPM vehicles. The guideway may require a minimum grade of approximately .5 percent to ensure adequate drainage of the guideway running surface.

The Laclede's Landing option has a maximum grade of 7 percent. This grade is required to achieve the minimum guideway clearance requirements over the Memorial Drive overpass. The 7 percent grade begins at stationing 210 + 00 on Alignment 4 (Figure 45). Therefore, if this option were included in Alignment 4 it would require a modification in the guideway elevation of the basic route from 210 + 00 to 220 + 00 to meet the grade requirements of the north and south lanes of the Laclede's shuttle. A high level station would be required at the east end of the Laclede's Landing shuttle due to the height of the guideway above the existing ground elevation.

GUIDEWAY LOCATION

The location of the guideway structure in the street right-of-way is important in minimizing the utility relocation costs and the visual and environmental impacts. Typically the guideway columns and foundations would be placed on the street edge in the parking lanes. For wide streets such as Tucker Boulevard, it would be possible to place the guideway down the center

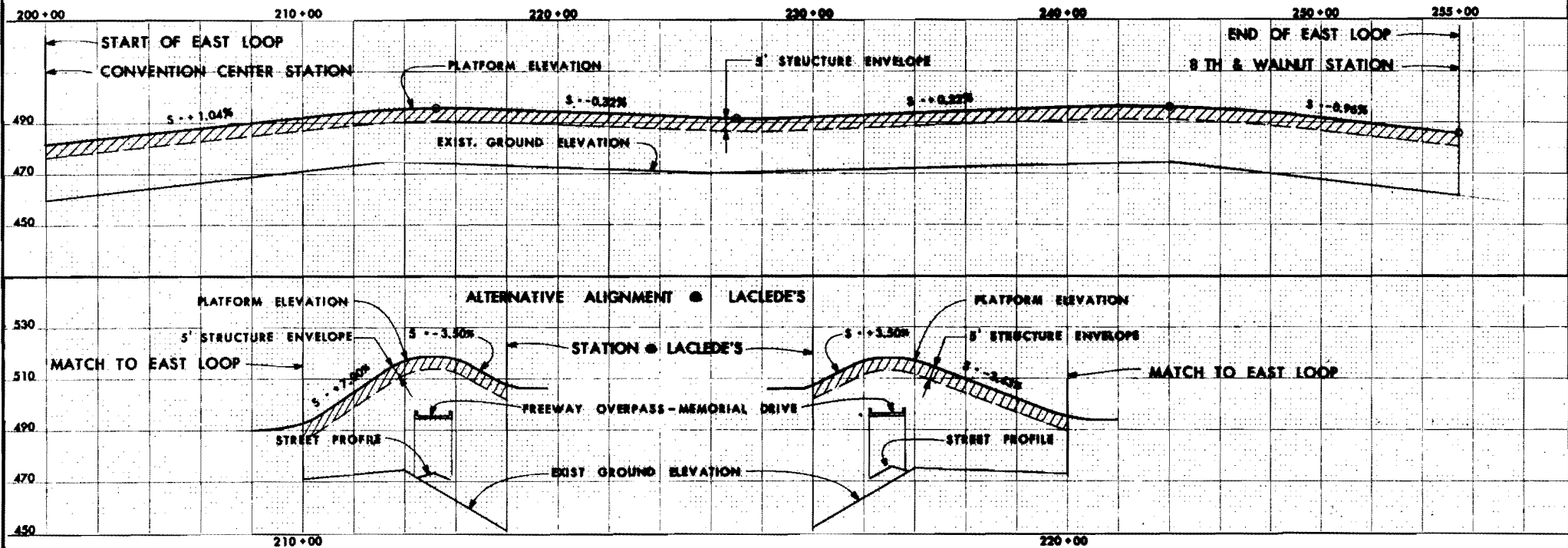
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St. Louis, MO

EAST LOOP PROFILE
(BASE ROUTE)

Booker/Bernard Johnson

ABAM
CONSULTING ENGINEERS
ONE SOUTH FIRST STREET, ST. LOUIS, MO 63101
(314) 241-1000

Figure 45



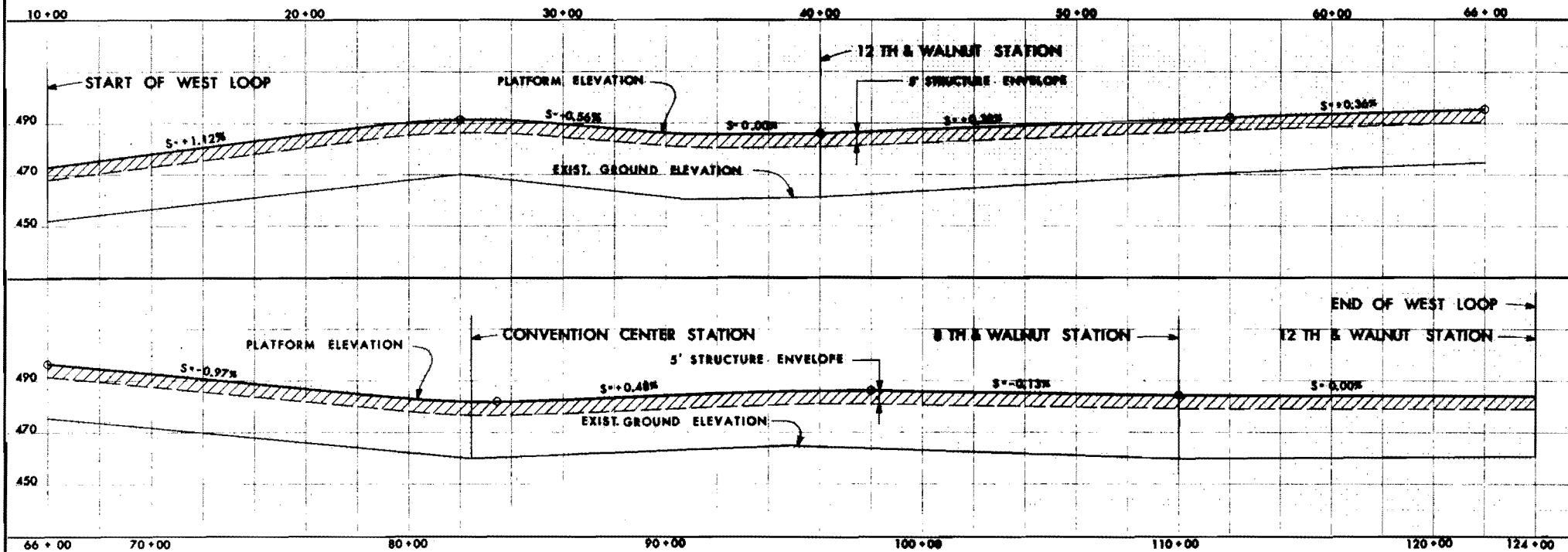
Downtown People Mover
Feasibility Study
St. Louis, MO

WEST LOOP PROFILE
(BASE ROUTE)

Booker/Bernard Johnson

ABAM
CONSULTING ENGINEERS
200 SOUTH 10TH STREET, SUITE 200, ST. LOUIS, MO 63104
(314) 241-1000

Figure 46



of the street without severely reducing the number of traffic lanes. A preferred side of the street for the guideway structure was determined for each street in Alignment 4 based on the subsurface utilities, patronage requirements and visual impacts. They are:

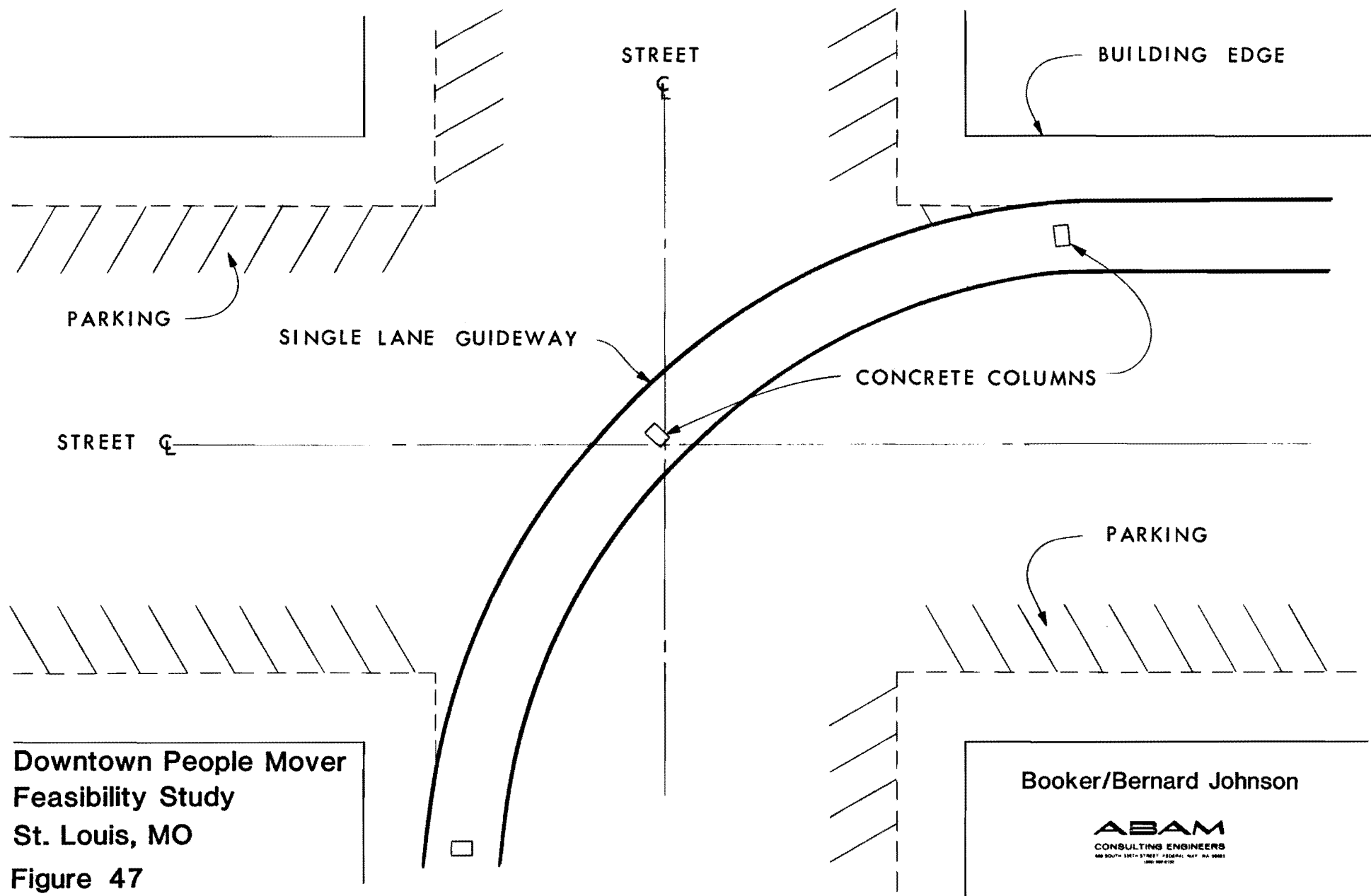
<u>Street</u>	<u>Preferred Side</u>
4th Street	East
8th	East
Tucker	West
Convention Plaza	North
Walnut	South
Clark	South

The location of the guideway in the street right-of-way is also important in determining the radius of curvature of the guideway at 90° street corners. A typical street intersection for the St. Louis DPM is shown in Figure 47. All of the streets in Alignment 4 have a preferred orientation so that the guideway turns from the outside of one street to the outside of the other. The curve radius for a standard street width of 66 feet is approximately 100 feet and the curved beam length is approximately 60 feet.

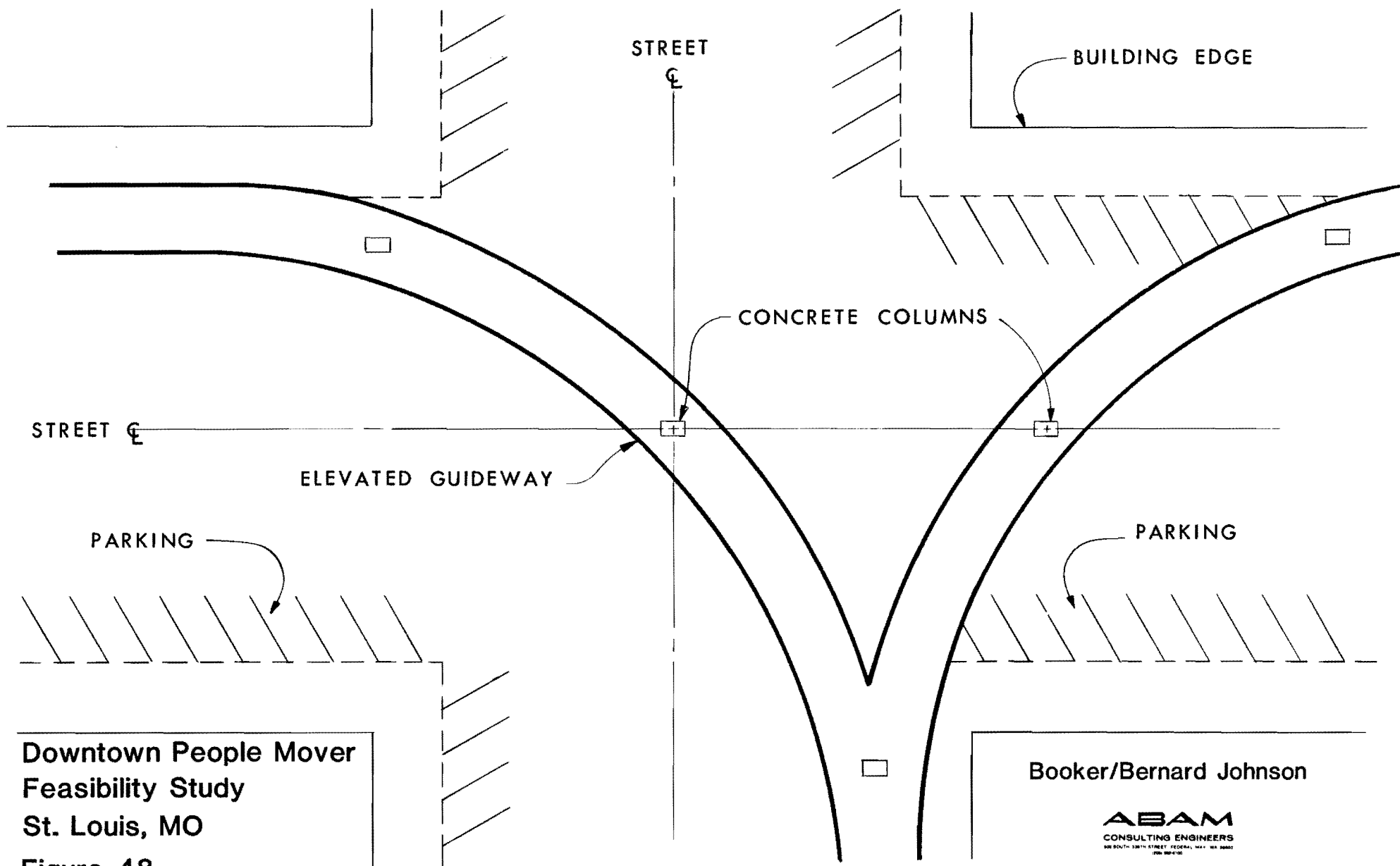
A typical intersection for Eighth Street with both Walnut Street and Convention Plaza is shown in Figure 48. The minimum curve radius is approximately 90 feet and the beam span lengths 60 feet. A switch would be required in the "Y" intersection to route some of the vehicles to the east loop and the other vehicles to the west loop.

ENGINEERING ISSUES

Alignment 4 and the options present engineering issues associated with the Eighth Street tunnel and Laclede's Landing.



PLAN - TYPICAL STREET INTERSECTION



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Figure 48

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PLAN - " Y " INTERSECTION

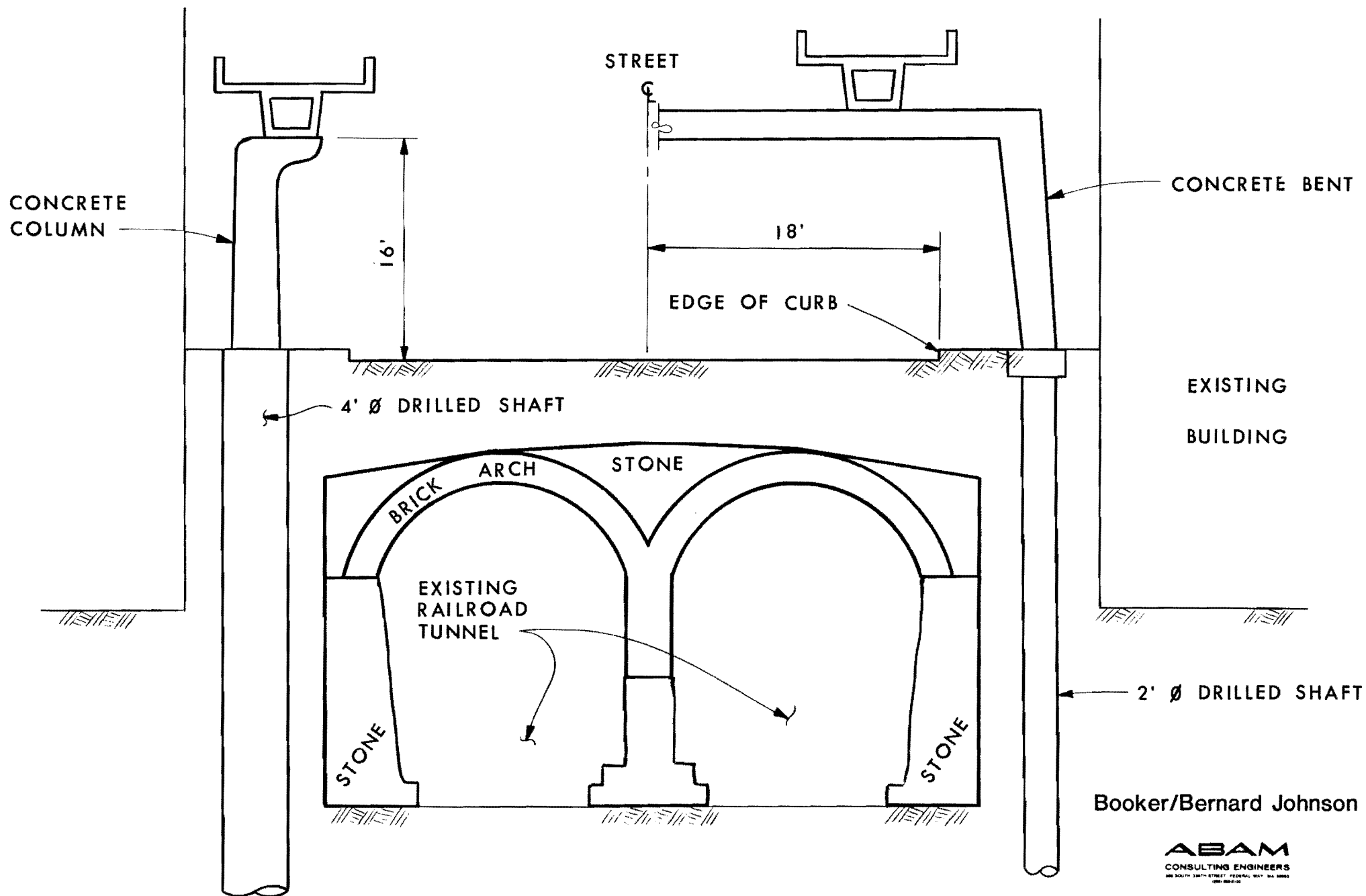
Eighth Street Tunnel

The Eighth Street tunnel is located below the guideway from Washington Street south to Walnut Street (see Appendix D for the detailed study of the tunnel). Figure 49 shows two construction options for the guideway along Eighth Street. The first construction option uses a four foot diameter drilled shaft foundation and a precast column. The second option uses a two foot diameter drilled shaft foundation and a concrete bent which spans from sidewalk to sidewalk. One advantage of the column concept is the reduced visual intrusion above the street. The concrete bent enables the guideway beams to be located closer to the street centerline, thus reducing the disruption to the existing buildings.

The Eighth Street tunnel presents another complication from Locust Street to Olive Street in front of the Old Post Office. Here the tunnel widens to the west and connects with the lower floors of the Old Post Office. This increased tunnel width precludes the use of the drilled shafts shown in Figure 49. The east side of the street has a 3-1/2 feet x 4-1/2 feet sewer line 30-35 feet below the street elevation.

If the guideway were located on the west side of the street some modifications to the tunnel may have to be made for the foundation placement. If the tunnel were to remain abandoned it may be possible to place the foundation in a portion of the railroad R.O.W. and have the foundations and columns in the parking lane. If the tunnel were to be used later for a transit system it may be possible to upgrade the structural integrity of tunnel with falsework to allow the foundation to be placed above the arch structure or to pass through the widened section of the tunnel.

Placement of the guideway on the east side of Eighth Street may necessitate the relocation of the 3-1/2 feet x 4-1/2 feet sewer. The cost of relocating the pipe is approximately \$3,800,000. This cost is due to the size of the pipe and its location below the tunnel. Another solution to the interference of the abandoned railroad tunnel and sewer line is to move the guideway from



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TYPICAL SECTION @ 8TH STREET

Figure 49

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(206) 884-1100

Eighth Street to Seventh or Ninth Streets. A relocation to Seventh or Ninth Streets would require further analysis of cost, patronage and land use studies to determine the feasibility of each solution.

Laclede's Landing

The Laclede's Landing option also presents engineering issues. The Memorial Drive overpass changes the basic profile of Alignment 4 by increasing the height requirements of the guideway. The overpass requires the structure to have long-span beam capabilities and increased column and footing capacities. The increase in footing and column requirements is due to the increase in height of the guideway structure over Memorial Drive and the increase in the loads from the longer beam lengths. The increased costs for the long-span beams and increased columns and footings are included in the Alignment 4 cost estimates (Table 26).

CONSTRUCTION COST

The estimated cost of the Alignment 4 alignment is shown in Table 26. The estimated costs for each option and the baseline costs are shown in Table 27. The total cost for Alignment 4 is \$75,216,000. The estimated cost increase of the Memorial Drive option is \$3,144,000 and includes an additional 800 feet of guideway structure, one vehicle and one station. The estimated cost increase of the Laclede's Landing option is \$3,780,000 for 1000 feet of additional guideway, two vehicles and no stations. The estimated cost increase of the Columbus Square option is \$6,221,000 for 1800 feet of guideway, three vehicles and one station.

Each estimate includes the increased engineering, managerial, administrative and legal, and contingency costs. The total cost of adding all three options to the base route is \$13,145,000. The total estimated cost for Alternative 4 and the three options is \$88,361,000.

TABLE 28
ST. LOUIS DPM FEASIBILITY STUDY
ALIGNMENT 4 - ESTIMATED COST

Route 4	Units	Number of Units	Cost Per Unit	Cost
Right-of-Way Acquisition	LS	--	--	\$ 400,000
Utility Relocation	LS	--	--	4,500,000
Demolition	LS	--	--	500,000
Street Modification	LS	--	--	500,000
Elevated Guideway:				
Foundation and Columns	EA	337	20,200	6,808,000
Beams	LF	20,200	400	8,080,000
Finishing	LF	20,200	500	1,010,000
Special Structures	LS	--	--	1,616,000
Administrative, Maintenance and Storage	EA	1	2,769,000	2,769,000
Basic Stations	EA	11	775,000	8,525,000
Fare Collection and Security	--	--	--	--
Vehicles	EA	24	524,000	12,576,000
Electrification	LF	20,200	250	5,050,000
Engineering Cost	LS	--	--	2,082,000
Construction Management	LS	--	--	2,777,000
System Management	LS	--	--	1,410,000
Administrative and Legal	LS	--	--	1,570,000
Contingency	LS	--	--	15,043,000
Total Estimated Cost				<u>\$ 75,216,000</u>

TABLE 29
ST. LOUIS DPM FEASIBILITY STUDY
ALTERNATIVE 4 AND OPTIONS - ESTIMATED COSTS

I.	Route 4 - Alignment	\$ 75,216,000
	Option 4a - Memorial Drive 400' additional guideway on Walnut and Pine Streets.	<u>3,144,000</u>
	Total - Baseline + 4a	<u>\$ 78,360,000</u>
II.	Route 4 - Alignment	\$ 75,216,000
	Option 4b - Laclede's Landing 100' Dual-lane shuttle.	<u>3,780,000</u>
	Total - Baseline + 4b	<u>\$ 78,996,000</u>
III.	Route 4 - Alignment	\$ 75,216,000
	Option 4c - Convention Plaza 900' additional guideway on 10th Street and Tucker Boulevard.	<u>6,221,000</u>
	Total - Baseline + 4c	<u>\$ 81,437,000</u>
IV.	Route 4 - Alignment	\$ 75,216,000
	Option 4a + 4b	<u>6,924,000</u>
	Total - Baseline + 4a + 4b	<u>\$ 82,140,000</u>
V.	Route 4 - Alignment	\$ 75,216,000
	Option 4a + 4c	<u>9,365,000</u>
	Total - Baseline + 4a + 4c	<u>\$ 84,581,000</u>
VI.	Route 4 - Alignment	\$ 75,216,000
	Option 4b + 4c	<u>10,001,000</u>
	Total - Baseline + 4b + 4c	<u>\$ 85,217,000</u>

TABLE 29, Cont.

VII. Route 4 - Alignment	\$ 75,216,000
Option 4a + 4b + 4c	<u>13,145,000</u>
Total - Baseline + 4a + 4b + 4c	<u>\$ 88,361,000</u>

The main refinement in baseline cost estimate is the utility relocation costs. A more detailed cost estimate was made based on the utilities located along each street of Alignment 4. The estimated cost for the relocation of utilities along Alignment 4 is approximately \$4,500,000. The estimate assumes the 3-1/2' x 4-1/2' sewer line located on the east side of 8th Street would be relocated since the east side of the street is the preferred location. The estimated cost of relocating the sewer is approximately \$3,800,000. If the guideway were located above the sewer line without relocating the sewer line or moved to the west side of the street the utility relocation costs would be approximately \$700,000.

Detailed costs of the stations are given in Table 28. The total cost before field engineering, contingency and tax is \$763,000. This number was rounded off to \$775,000 for the system cost summaries.

The cost estimate for the Laclede's Landing option reflects the increased guideway cost due to the long beams required to span the Memorial Drive overpass. The increased column and footing costs due to height requirements over Memorial Drive are also included in the cost estimate. The cost estimate for the Laclede's Landing option assumes the station at 4th and Convention Plaza would be moved to the end of Laclede's Landing shuttle with no additional station costs.

ECONOMIC AND DEVELOPMENT IMPACTS

Alternative 4 will provide the maximum level of economic and development impacts. This is due to: 1) the large number of stations in this alternative; 2) the options under study; and 3) the maximum coverage of the CBD provided by this alignment. This 13 station alternative serves 98 percent of the 1985 CBD employment, 98 percent of the CBD floor space, all of the CBD class A hotel space, and over 20,000 of the CBD parking spaces in structures. The station by station joint development potential analysis indicated that 8 of the 13 stations had excellent to good long term potential and 6 had excellent to good short term potential.

TABLE 30
ST. LOUIS DPM FEASIBILITY STUDY
TYPICAL STATION COSTS

<u>COST COMPONENT</u>	<u>COST (1980 Dollars)</u>
Concrete	\$ 214,000.00
Metals	3,020.00
Thermal and Moisture Protection	112,390.00
Doors and Windows	60,950.00
Finishes	17,540.00
Specialties	74,500.00
Conveying System	180,000.00
Mechanical	51,500.00
Electrical	<u>49,100.00</u>
TOTAL ESTIMATED COST	<u>\$ 763,000.00</u>

Cost estimate prepared by Scott-Thomas Associates, Inc., St. Louis, Missouri. Cost estimate in 1980 \$.

Each station location of Alternative 4A are described below. These descriptions contain land uses at the station location as well as an indication of the short term and long term development potential associated with the station location. Following the station location descriptions is a discussion of office and retail potential associated with the selected alignment.

STATION AREA DESCRIPTIONS

18th and Clark Streets

This station is proposed for the corner of the Post Office building and St. Louis Station. These two facilities are on the northeast and west quadrants of the intersection respectively. The southeast intersection is the abandoned REA Express Building, with 50,000 square feet, all available for lease. Beyond the REA Express Building is the Norfolk and Western right-of-way and U.S. 40 (elevated). East of the REA Express Building, at the intersection of 16th and Clark, are parking lots and single story manufacturing buildings of limited utility. The present market image is poor, due to the vacant building and location at the rear of the Post Office and St. Louis Station. The area could be significantly improved in the long term, if St. Louis Station is built and innovative rehabilitation is performed in the REA Express Building (although this is doubtful at the present time). The short term joint development potential at this location is provided by the Union Center facility. Short term potential is therefore good and long term potential would be enhanced significantly if the Union Center Project is built.

14th and Clark Streets

The northwest corner of this intersection contains a multi-story parking structure that serves City offices and the Keil Auditorium. The southwest corner has an electric company substation that is surrounded by parking lots and vacant land. The southeast corner consists of an entrance ramp to U.S. 40 and at the northeast section there is a courthouse style building that contains the Community Services Administration. Beyond the highway

interchange on the southeast corner is the Edison Brothers Storage, Inc., a 12-story warehouse facility. The market image of this location is poor as it is the "rear entrance" to buildings on Market Street. There is little joint development potential to the south of this intersection; however, the many City offices along Market Street would provide substantial ridership for a DPM. The existing land uses and poor market image indicate that the short term development potential of this station is very poor; the long term development potential is classed as poor.

12th and Walnut Streets

This location includes the City Hall to the west of the intersection and the Municipal Courts Building on the northeast. The southeast intersection includes a 3-story building (28,000 square feet) that is for sale or lease. In the same block is a 5-story old industrial building (the Missouri Furniture Building), a parking lot and an old office building now used by the Board of Election Commissioners. Generally, the block is underutilized. This station location has good short term development potential because of the amount of vacant/underutilized land on the southeast corner of the intersection. Ridership would be good because this is the edge of the CBD with many Court buildings nearby. The long term joint development potential is excellent given the potential of the southeast corner and the possibility of interface with rehabilitated existing structures. DPM access to this area can provide incentive for CBD expansion towards the southwest. Also, it will increase CBD access to employees in this area.

12th and Locust Streets

The northwest corner is dominated by the recently renovated Jefferson Arms Apartments and hotel complex. The northeast corner has an auto rental office and two other small retail buildings on the block. These are mostly low intensity uses that are marginal in the scope of downtown development. The largest building on the block between Locust and St. Charles is five stories. There is also vacant land on the block, now in use as a parking lot. The southeast corner contains the Missouri State Bank and Trust Company Building, its attached parking garage, the KSDK TV offices, and smaller retail

buildings. The southwest quadrant contains a parking lot on the east half of the block and the Christ Church Cathedral on the remainder of the block. The market image of this site is fair to good because there are no high intensity uses or major activity centers, and this location is near the edge of the CBD. Given the variety of uses and amount of vacant/underutilized land, there is a medium level of short term development potential at this location. The long term development potential is judged to be good. With a wide variety of uses, including the Jefferson Arms Apartments on one corner and a significant office structure on another, this location has the potential to generate a DPM joint development project.

12th and Delmar Boulevard

The southwest quadrant of this intersection contains a service station and a few single story retail buildings. The southeast corner houses the Globe-Democrat Building, taking up the entire block. The northwest corner consists of a one block parking lot with a very small restaurant on the site. The northeast block is the Sverdrup and Parcel (S&P) Building. To the southwest, beyond the service station there are industrial buildings ranging from 3 to 7 stories. At the corner of M. L. King Drive is the St. Louis Post Dispatch Building. There are parking lots to both the northwest and northeast beyond the immediate station location. This site is the extreme outer edge of downtown and has a poor market image. There is very little demand for land in this area and, therefore, only limited short term development potential. Long term potential is average, due to the proximity of the of the Globe-Democrat Building on one corner and the large amounts of vacant land available. A DPM station at this location could, in the long term, generate sufficient developer interest to expand CBD development to include this fringe area.

11th and Cole Streets

North of this intersection is cleared vacant land that is the site of the future Columbus Square Apartments. The southeast corner is a vacant grass-covered parcel and the southwest corner is a three story parking structure, serving the Sverdrup and Parcel Building. Further to the east is

the back of the new Convention Center. The Radisson Hotel (under construction) is a block to the southeast. Although the present market image of the area is only fair to good, the proximity to the Convention Center and plans for the area make this a viable location for joint development projects. Because the timing of development will be critical here, the short term development potential at this intersection is estimated to be good. The long term development potential is projected to be average because future plans for the area will reach construction stage in the near term and will be completely developed in the long term. Integration with the planned Columbus Square Apartments and/or developments on the presently vacant sites will be an important issue at this station location.

8th and Market Streets

The block to the northwest is largely used as a parking lot. The structures on the block are small, one to four-story buildings, two of which are being rehabilitated and leased by the Lipton Company. In general, the entire quadrant appears to be in a state of transition. The southwest corner is the site of the IBM/Equitable/First National Bank building which is under construction. The southeast block is the site of the General American Life Insurance Company, a modern five-story building. Further to the southeast is the Stadium and many parking lots that serve the Stadium. The eastern sector contains the Marriott Pavilion Hotel which is currently being expanded via addition of a second tower. On the northeast corner of this station area is the Buder Building, the International Building, and the Pioneer National Title Insurance Building, all of which are older Class "B" office spaces with many vacancies. This block is slated for demolition and incorporation into the linear park system. One block from the site at the northeast corner of 8th and Chestnut Streets is the new state office building, now under construction. The market image of this area is excellent because of its prime location with respect to the downtown real estate market. However, the land uses at this location would be difficult to alter to accommodate a joint development project. The greatest amount of interface that might be possible is after the fact physical integration of a DPM station into the

IBM/Equitable/First National Bank Building. However, integration without new development does not constitute true joint development.

8th and Olive Streets

The southeast corner is dominated by the Laclede Gas Building that houses the Bank of St. Louis and many other private offices. The northeast corner has the Chemical Building, an old red brick office building with first floor retail, the 705 Olive Building, and the United Missouri Bank Building that is presently being rehabilitated. The block on the northwest is entirely made up of the Old Post Office that is presently undergoing rehabilitation. The southwest corner contains the Arcade Building with first floor retail uses as well as the Paul Brown Building. The principal plans for the area are the rehabilitation of the Arcade Building. The market image of the area is presently very good and will improve when the Post Office rehabilitation is completed. While this area is essentially the heart of the downtown, there are vacant retail and office spaces in the Arcade Building. Joint development potential at this site is excellent in the short term, particularly if interface is made with the Post Office or Arcade Building rehabilitation projects. Long term potential is somewhat reduced if it is assumed that key developments will take place in the short term. The Arcade Building and/or the Chemical Building also offer development potential to integrate with a DPM and create new mixed uses. A DPM station, integrated with one or both of these buildings can enhance the rehabilitation proposals to assist in generating sufficient private interest.

8th Street and Convention Plaza

Eighth and Delmar is the entrance to the Convention Center. Also at this location is the pedestrian overpass which connects the Convention Center to the surface parking lot and the multi-story parking structure that is on the southeast corner of 8th and Convention Plaza. The Radisson St. Louis is to the west of the Convention Center and to the east of the Convention Center are a large parking lot and the Greyhound Bus Terminal. The market image of this area is rapidly improving, given the immediate proximity of the Convention Center, the new Radisson Hotel, and the available vacant land. As

a result, joint development potential at this location is excellent in both the short and long term futures.

Broadway and Walnut Streets

The northeast corner of this intersection is the Equitable Building, one of the newest office buildings in downtown St. Louis. The southeast quadrant contains a multistory parking structure serving the Stadium, the Equitable Building, the Marriott Pavilion Hotel, and other nearby uses. The garage has direct access into the Equitable Building. The Stadium consumes the entire southwest quadrant of the intersection and the Marriott Pavilion Hotel is on the northwest corner. The Marriott Hotel is in the process of building a second tower to create more hotel space. One block eastward, towards 4th Street is the Gateway Arch and the Stouffer's Inn, one block to the north is the historic Old Courthouse Building (now being rehabilitated) and the Chestnut/Market Street Mall that is highly used in good weather. The market image of this intersection is excellent and could be an excellent place for a station.

However, the uses at this location do not offer significant joint development potential due to the unalterable nature of the land uses. Ridership at a station at this location is guaranteed to be very high and Stadium access, although not accounted for in ridership projections, will provide substantial numbers of patrons to the DPM system. The proximity to the Stouffer's Inn and potential for direct access to the Marriott Pavilion Hotel and the Equitable Building can provide these sites with important access to major activity centers elsewhere in the CBD. Therefore, although there is limited joint development potential, station interface with the surrounding uses will foster an extremely active DPM station.

Memorial Drive and Chestnut Street

The northwest corner is the site of Pierce Building that recently was designated by WRC of Missouri, Inc. as a major office renovation project. The remainder of the block, presently a parking lot, is the site for the recently announced construction of a Western International Hotel to be built

in conjunction with the office renovation. Memorial Drive and the Mark Twain Expressway limit access to the Gateway Arch to the east of the station location but it is assumed that direct, safe pedestrian access to the Arch would be provided from a DPM station at this location. The block to the southwest of this intersection is part of the Market Street Mall. The market image of this site is excellent given the importance of the Gateway Arch as a tourist attraction. The renovation and new construction planned for the northwest block provides outstanding opportunities for joint development projects, but this is the only corner that could be used for station joint development; the remaining corners have unalterable land uses. The joint development potential is excellent in the short term, and good in the long term since the timing of any DPM commitment is the critical factor. A true opportunity exists only if the DPM decision is made prior to final design of the new/renovated structures. Once construction is underway, the potential is seriously diminished, if not totally lost.

4th and Locust Streets

On the southwest block are the Security Building, the Marquette Building and a parking lot. The northwest corner is comprised entirely of the Federal Reserve Bank Building. The eastern quadrant is all part of the Mansion House Center Complex with the airlines offices, the Holiday Inn, and private apartments noted in earlier site descriptions. The market image of this intersection is excellent. The Security Building is older but contains viable office space. The prime impetus for joint development at this site would come from the Mansion House Center Complex. There are already many existing retail uses at this location and a joint development project at this site can enhance and intensify these uses. The short term potential at this site is average but the long term potential is good.

The improvement in development potential over the long term relates to the present form of development now in the area. It is unlikely that in the short term any significant changes will be made to land uses at this location since the businesses at and near the site are viable. However, in the long term, changes in the real estate market, the natural progression of aging and

the presence of a DPM station together may create a situation (especially at the Mansion House complex) that enhances the possibilities for joint development projects. As the business fortunes of firms at this location rise and fall, there may be times in the future when it would be more appropriate to attempt new forms of development at this location.

4th Street and Lucas Avenue

The southeast corner of this intersection is the site of the Belair Hilton Hotel. The southwest corner contains the Missouri Athletic Club, a private club. The northwest corner is shared by the Continental Trailways bus facility and buildings related to the Missouri Athletic Club. There is no northeast corner as the Mark Twain Expressway takes up that quadrant. The intersection is at the furthest northeast corner of the Central Business District. Although it is an active intersection, its potential is limited due to the proximity of the expressway and the limited amount of vacant land. Unless the Missouri Athletic Club were to relocate (there are no such plans in the near future), there is a little potential for new development to take place. As such, the joint development potential is average at best. The long term development potential is good if the Hilton Hotel property is used to full advantage and expanded in conjunction with a station at this location. This site offers limited access to the Laclede's Landing area. However, pedestrian access at this time is underneath the expressway and this barrier severely limits the viability of this location as an appropriate access point to Laclede's Landing.

Laclede's Landing

A station located in the central core of the Landing would provide substantial access to all sectors of the Landing. A central location would thus provide attractive development potential and would also make possible a wide choice of possible joint development locations. There is ongoing discussions of a Hyatt Hotel being located in the core of Laclede's Landing. A facility of this type would make an ideal candidate for integrated joint development, with the DPM station incorporated into a "sky lobby" at the

appropriate evaluation and serving as a gateway to the entire spectrum of shops, restaurants and other activities in the Landing.

This is not the only possible method of penetrating Laclede's Landing but it certainly represents an attractive solution for both the public and private sectors--the developers would receive a substantial comparative market advantage for their investment and the public would benefit from a reduction in the cost of station construction and maintenance. If the timing of development and DPM system commitment can be coordinated, the short term opportunities appear to be excellent. The long term potential is somewhat less attractive due to the timing issues associated with new and proposed developments in the Landing area.

A DPM station serving Laclede's Landing would be of significant benefit for the area's continuing development and revitalization. The elevated Mark Twain Expressway is an effective barrier to pedestrian access and serves to isolate the Landing from the CBD. A DPM link would pierce this barrier and re-unify the Riverfront and the downtown.

OFFICE DEVELOPMENT POTENTIALS

The determination of the "range of influence" that the proposed DPM alignment could exert on downtown St. Louis office space development requires a comparative examination of similar analyses completed in first tier DPM cities (St. Paul and Los Angeles). The applicability of these previous "range of influence" analyses for downtown St. Louis is noted. Based upon this cross sectional analysis, and the prior examination of existing conditions, past trends, committed projects, and baseline forecasts, estimates can be generated for downtown St. Louis.

In order to determine the "range of influence" of the DPM system on key impact measures, an analysis was made of the "with" and "without" DPM scenarios. Local field investigations confirm that both Los Angeles and St. Paul had: 1) historically been capturing a declining percentage of their

respective regional office market; and 2) previously lost two or three major corporate headquarter operations to suburban activity centers. In the case of the future capture regional office space, it was the consensus economic view that the DPM could slow down or stabilize the rate of market share lot, but not completely reverse it. The degree of change varied from two percent in Los Angeles (i.e., a six to seven percent increase in the overall regional capture rate) to 2.5 percent in St. Paul (i.e., an 11 to 12 percent increase in the overall regional capture rate) The capture rate of internally generated office demand was estimated to increase from 50 to 60 percent in both Los Angeles and St. Paul. Similar to these situations, St. Louis has also been experiencing a declining share of regional demand and has a potentially greater rate of internally generated office demand.

Because Los Angeles currently has a stronger office market than St. Paul, the DPM system's influence on committed projects was estimated to be greater in Los Angeles. The "net" influence in scale of development was estimated to be on the "order of magnitude" of one to two Floor Area Ratios (FAR) in Los Angeles and one FAR in St. Paul. The construction schedule of committed projects were anticipated to be accelerated by 12 to 24 months.

The magnitude of estimated DPM induced office space demand ranged from approximately 500,000 square feet (St. Paul) to 1,800,000 square feet (Los Angeles). In percentage terms, the "net" gain anticipated over the "without" DPM situation were quite similar, 5 to 5.5 percent. These estimates of DPM induced office space demand only took into account changes which would occur during the first five to six years of system operation.

From the viewpoint of "regional transfer" versus "net gain" to the region, most of the induced growth is considered a transfer from another part of the metropolitan area. In the case of Los Angeles, some of the anticipated induced development could even be attractive from alternate locations within the city itself. Between 20 to 25 percent of the induced growth was viewed to be a potential net gain to the individual regions. The basis for this calculation is the DPM system's ability to enhance the visibility and

prestige location advantages of either CBD in relation to national corporate headquarters locations. This was especially true for Los Angeles. In St. Louis, the locational decisions of regionally based firms should be impacted by the DPM, increasing the competitiveness of the CBD vis-a-vis the potential suburban office locations.

On a preliminary basis, the induced commercial office space demand resulting from implementation of a full functionally integrated DPM system would be approximately 100,000 gross square feet per year. This compares to the estimated baseline projection of approximately 500,000 square feet per year through 1990.

This initial estimate is subject to revision after more detailed station area and economic/market joint development studies are completed. The induced absorption rate is primarily predicated on increases in the capture rate of internally generated demand and takes into consideration: 1) the low level of significant committed projects (with the exception of the IBM/Equitable/First National Bank Building); 2) the currently low level of regional market capture; 3) the probability that significant lower level office space will be upgraded as a result of the people mover; 4) the competitive attractiveness of a DPM office site to a potential regional headquarters building; and 5) the general conservative nature of previous baseline projections.

Retail Potentials:

To determine the "range of influence" of the DPM system, a separate analysis should be made of the differential situation both with and without the DPM system in operation. Local field surveys should be made of noon-time shoppers to verify current per diem/per capita sales expenditures and to determine and evaluate the current pedestrian domain and possible changes. In addition, the current sales per square foot ratios of all major retail facilities within the downtown must be determined and confirmed through field surveys or other sources such as state sales tax returns and/or recent census

data. This type of analysis has been conducted in first tier DPM cities and would be required in further analyses of the St. Louis DPM system.

In the first tier DPM cities, as a result of the prevailing low level of sales per square foot (i.e., \$60 to \$90) in both St. Paul and Los Angeles, it was speculated that the strongest economic influence of the DPM system would occur in retail sales volume increases rather than any induced increment of new retail facility development. In St. Louis, it also appears that the "induced" retail sales resulting from the DPM system would: 1) increase the market support for new and improved retail facilities; but, 2) probably will not add to the current overall inventory of retail space in the CBD.

In previous studies of St. Paul and Los Angeles, RHA made several important observations regarding the "range of influence" of a DPM system on CBD retail sales. In St. Paul, a direct linkage with 6,800 state office employees now isolated from the CBD was an important aspect of increasing overall retail sales development. This improved linkage, in fact, was more important to estimated retail sales gains than the other categories of induced DPM development. In Los Angeles, the highest increment of increased retail sales volume was: 1) attributed to an expansion of the pedestrian domain in Los Angeles; and 2) a resultant increase in per capita and annual sales volume expenditures. In St. Louis, it appears that the most significant impact of the DPM system affecting retail sales would also be: 1) an expansion of the "pedestrian domain"; and 2) an increase in what now appears to be relatively low levels of annual per capita retail sales expenditures by downtown employees.

The magnitude of estimated DPM induced retail sales within the other first tier cities evaluated ranged from approximately \$30 million in St. Paul; to \$90 million in Los Angeles. In percentage terms, the net gain anticipated over the "without" DPM situation in these two communities were quite similar, both approximately 10 percent. These estimates of DPM induced retail sales activity reflect only changes which would occur during the initial operating period of the DPM system.

From the viewpoint of regional "transfer" versus "net gain" to the region, most of the induced retail sales increases within the downtown are considered to be a transfer from the other parts of the city or the metropolitan area. In the case of Los Angeles, a portion of the anticipated induced retail sales would probably be attracted from alternate locations within the city. It is estimated that between 15 to 20 percent of the projected induced growth in DPM related retail sales reflects a true "net" gain to the region. The primary source of this net increment to the region is the overall increase in retail sales demand generated by the visitor market and the small proportion of the new office employees market which reflects office uses which would not have been located within the metropolitan area had an operating DPM not been developed. The basis for this estimate is the ability of the DPM system to: 1) enhance the visability, prestige, and locational advantage of the CBD in relation to other national corporate headquarters; and 2) attract additional national convention trade because of the improved accessibility and enhanced market image created by the DPM.

On a preliminary basis, RHA has made initial estimates of the induced retail sales impact of the implementation of the St. Louis DPM system on CBD sales through 1990. Based on the comparison of relevant market indicators that would be effected by the DPM system in St. Louis, RHA estimates that between initial operation and 1990, retail sales in downtown St. Louis would increase from \$209 million in 1977 to approximately \$250 million as a result of DPM system implementation. (This assumes that relative sales remains constant from 1977 through 1990 and that the value of the dollar in 1977 remains constant.) This estimate takes into consideration the induced office, residential, and hotel development that would occur as a result of the DPM.

In addition, this estimate assumes increases in per capita or annual expenditures by the various demand segments due expansion of the pedestrian demand in downtown. For example, over the 1980 to 1990 period, it is assumed that per capita expenditures for downtown employees will increase 25 percent with the improved accessibility of the DPM, versus only a ten percent gain expected to occur without the system. Furthermore, it is assumed that

residential expenditures for persons residing in the downtown area will increase from 10 to 20 percent with DPM system in operation.

Large increases in expenditure patterns are projected for downtown visitors who are provided an easily retraceable route on the DPM from hotel and convention sites to the downtown retail core. It is estimated that the retail expenditure increase per visitor day to the downtown will rise from 10 to 30 percent over the projection period as a result of development of the DPM.

It is further assumed that relatively minor changes would occur in the capture rate of downtown CBD retail sales from the regional market. The magnitude of this DPM induced change estimates represent approximately a 10 percent increase in the overall market capture rate.

This gain in the downtown's capture rate of overall metropolitan demand is relatively modest, emphasizing the improved attractiveness of the downtown as a result of: 1) the induced activity generated by the DPM; and 2) the DPM system itself. Furthermore, these moderate increases in regional capture rate still result in a decline in proportion of overall downtown sales that would be derived from metropolitan demand.

The relatively high proportional increase forecast for downtown St. Louis reflects the high degree of linkage and accessibility that the proposed DPM system affords downtown employees, residents, visitors, and metropolitan area shoppers to existing and proposed new retail facilities. Particularly if the DPM system is a major integral element in the proposed May Mall, it can result in the proportionately larger induced impact than would ordinarily be expected.

It should be emphasized, however, that these preliminary estimates are subject to major revisions given the extremely limited amount of market segment data already obtained. Further indepth market analysis and market

segment studies are necessary in order to confirm these initial DPM induced retail demand observations.

PATRONAGE

The 1985 weekday patronage for Alternative 4 as stated in Chapter 4 is as follows:

Alternative 4 - 46,700
with options - 50,700

Alternative 4 stations were categorized by level of anticipated activity based on: development potential, existing development, location of transit and parking, and employment and hotel locations. Table 29 shows the stations in Alternative 4 categorized by low, medium and high activity levels. Stations with high activity levels tend to be in dense employment areas or areas which capture commuter traffic. Several stations were identified as impacted by special events which would have high volumes on event days. For example, the station near the Arch would generate more patronage in seasonal peaks and on weekends.

TABLE 31
ST. LOUIS DPM FEASIBILITY STUDY
STATION PATRONAGE ACTIVITIES - ALTERNATIVE 4

<u>Station</u>	<u>Average Weekday Patronage Category</u>	<u>Comments</u>
18th & Clark	High	
14th & Clark	Low	
Tucker & Walnut	Medium	
Tucker & Locust	Medium	
Tucker & Convention Plaza	Low	
11th & Cole (option)	Low	
8th & Convention Plaza	High	Special Event Impact
8th & Olive	High	
8th & Market	Medium	Special Event Impact
Broadway & Walnut	High	Special Event Impact
Memorial & Chestnut (option)	Low	Weekend & Seasonal Peaks
4th & Locust	Medium	
4th & Lucas	Low	
Laclede's Landing (option)	Medium	

ENVIRONMENTAL, VISUAL, AND HISTORIC IMPACTS

EMISSIONS

Positive benefits will result from the DPM intercepting all local Bi-State bus routes before they penetrate the CBD. Plus, the driving public will also be encouraged to use fringe parking lots. These two approaches are estimated to save 2,716,734 WMT a year and 115.83 metric tons of pollutant burden (primarily carbon monoxide) per year from being added to the atmosphere.

ENERGY CONSUMPTION

As discussed in Chapter 4, energy consumption will depend on the type of automated guideway system selected. The systems described in Chapter 4 are energy efficient and when compared to other alternatives, i.e., a bus-only system, rank much lower in energy consumption.

NOISE

The noise associated with the DPM will have no significant impact on the St. Louis CBD because of two factors: 1) the ambient noise levels in the CBD¹ will generally be higher than that generated by the DPM and 2) no sensitive receptors are located adjacent to the preferred alignment.

Depending upon the system selected to serve St. Louis, observed DPM noise levels (25 feet from the guideway and at the elevation of the vehicle) will vary from 61 dbA to 78 dbA².

The actual measurement of sound is most commonly done on the "A-weighted decibel scale" or dbA. Because of the logarithmic nature of the dbA scale, adding two sounds of the same intensity does not result in a doubling of the dbA level but an increase of 3dbA, regardless of the base noise level. Thus, if a DPM system at 70 dbA is added to an ambient street noise level of 70 dbA, the resulting noise level is 73 dbA.

¹ Average CBD street traffic noise as listed by B&K Instruments, Inc., is 82-85 dbA.

² Nussbaum, E. and B. Zumwalt, Mitre Corporation, Environmental Impact Issues for Automated Guideway Transit Systems, 1976.

To the average citizen, reported noise levels have little meaning unless they can associate the level to everyday situations. The following list gives typical situations and the noise level associated with it.

soft whisper at 5 ft. distance -----	30-35 db
business office -----	50 db
large store -----	60 db
vacuum cleaner at 10 ft. distance ----	70 db
normal speech at 1 ft. distance -----	70 db
passenger car, 65 mph at 25 ft. -----	77 db
diesel truck, 40 mph at 50 ft. -----	84 db
loud motorcycle at 25 ft. -----	90 db

The issue of how vibration will affect the older buildings adjacent to the preferred alignment may be raised. Research data accumulated by the U.S. Bureau of Mines indicate that it is most unlikely that vibration can crack plaster or otherwise damage structures on abutting property. In fact, it will be unusual to find abutting property where such vibrations can be felt even though the threshold for perception is much lower than the threshold for possible structural damage. The only practical way to reduce vibration is to increase the distance between the receptor and the guideway.

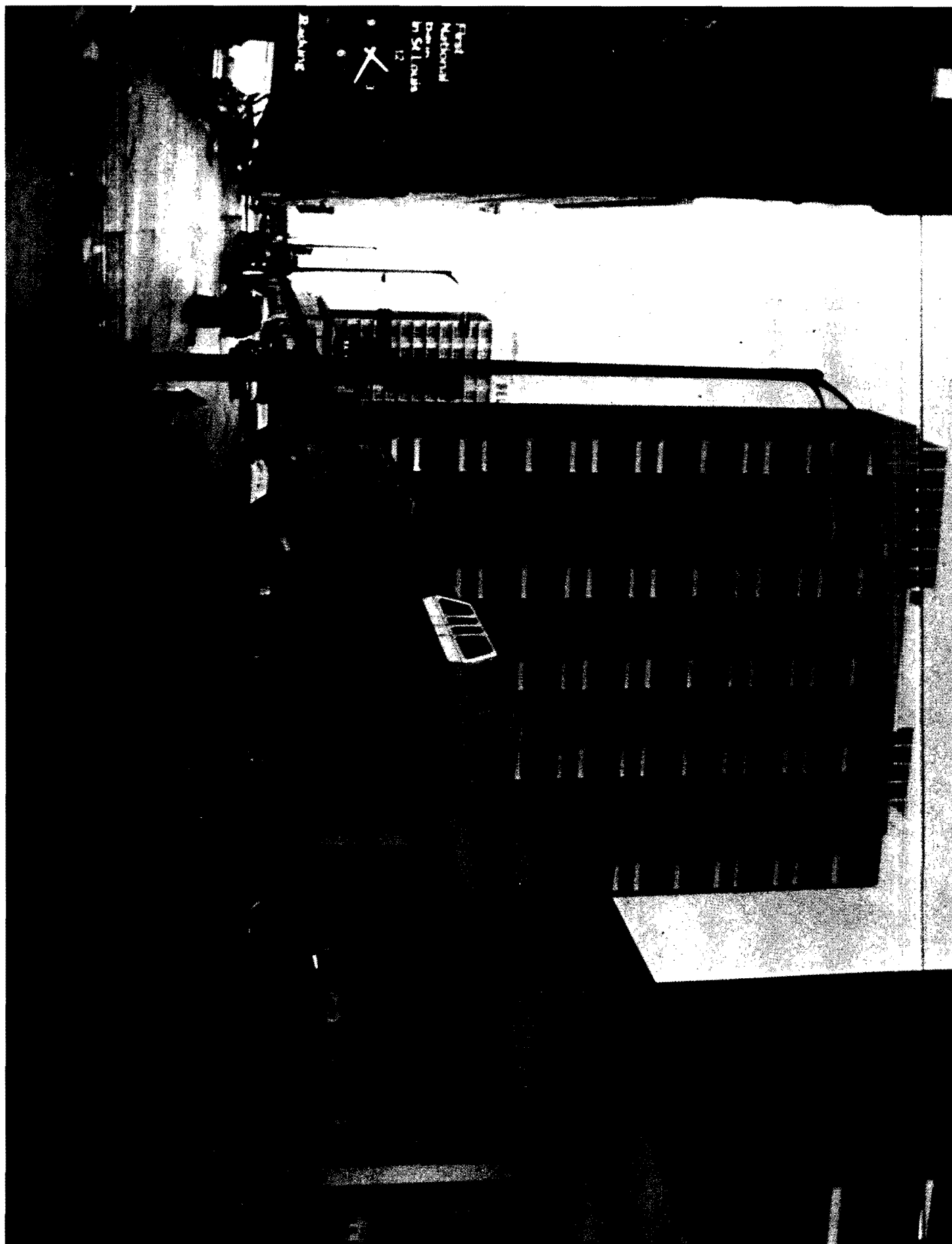
AESTHETIC QUALITY

The DPM will have a definite impact on the physical appearance of the St. Louis CBD. The following photomontages of a DPM system visualize how the DPM will look at select locations along the preferred alignment. A typical station design is also shown in Figures 50 and 51.

Of prime concern will be the visual impact of DPM stations and guideways. Properly designed and located, the stations could have the potential to enhance an area. The preferred alignment crosses the Gateway Mall at three locations: 4th, 8th Streets, and Tucker Boulevard. Sensitivity to the vista created along the Mall must be incorporated into the design of the guideway at these locations.

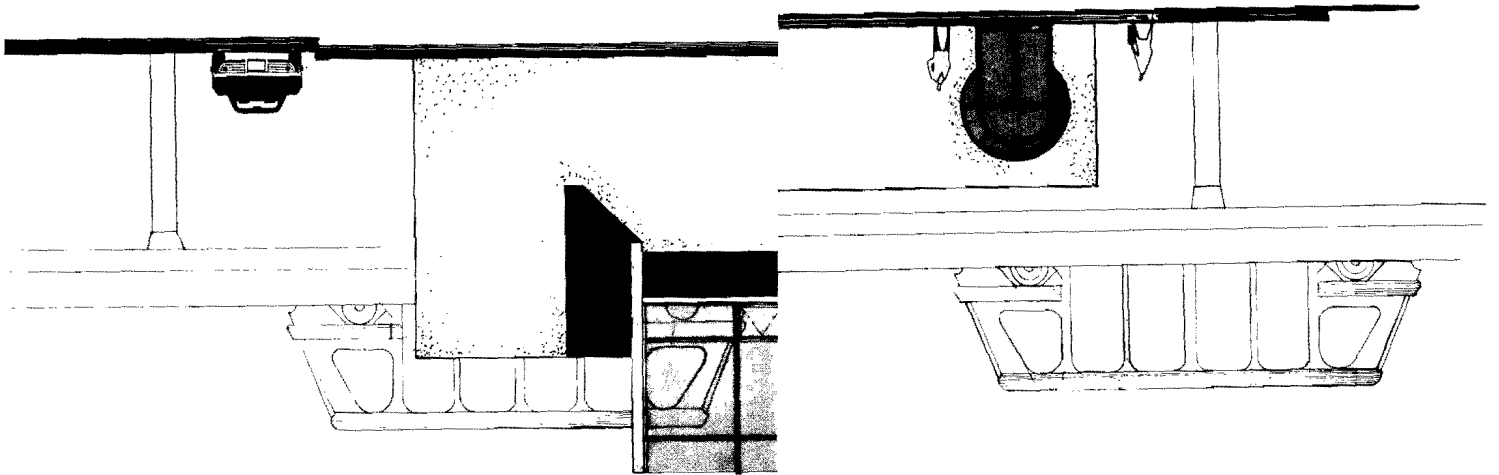


First
National
Bank
in St. Louis
12
X
1
Building



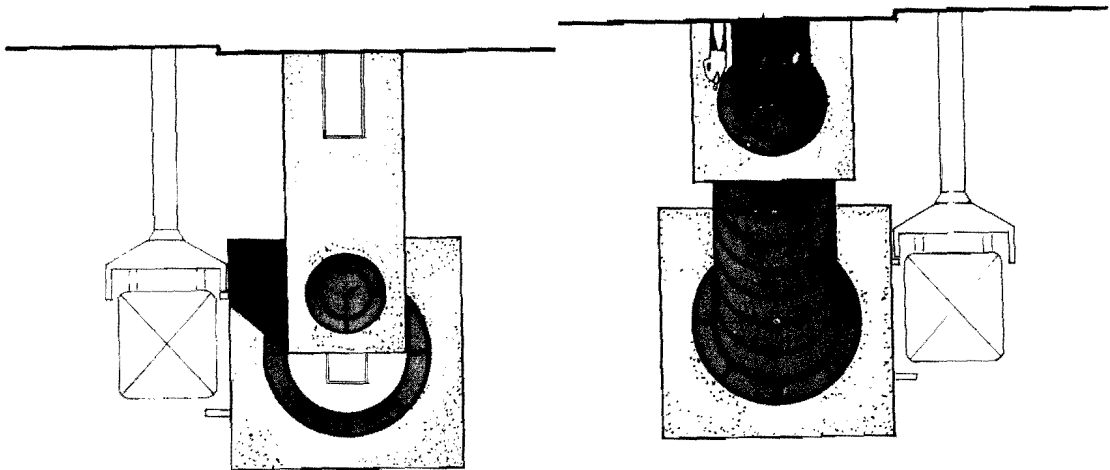
ST. LO
TYPICAL
BOOKER / B
SCOTT-THO

LONGITUDINAL



END ELEVATION

END ELEVATION



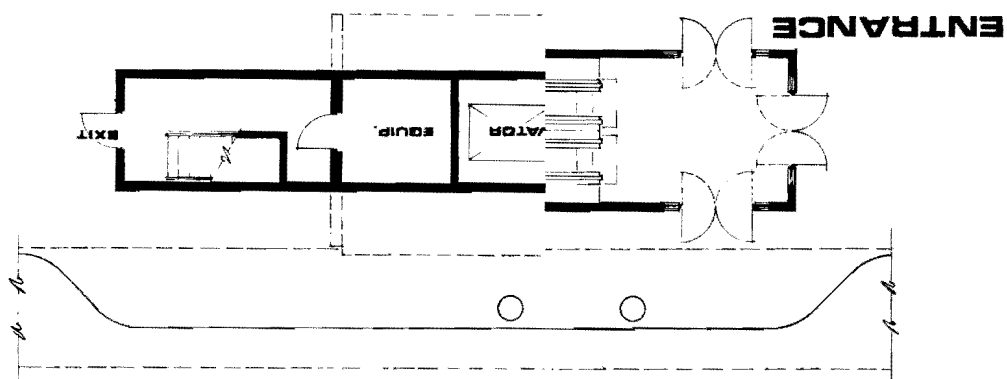
ST. LR TYPIC

BOOKER /

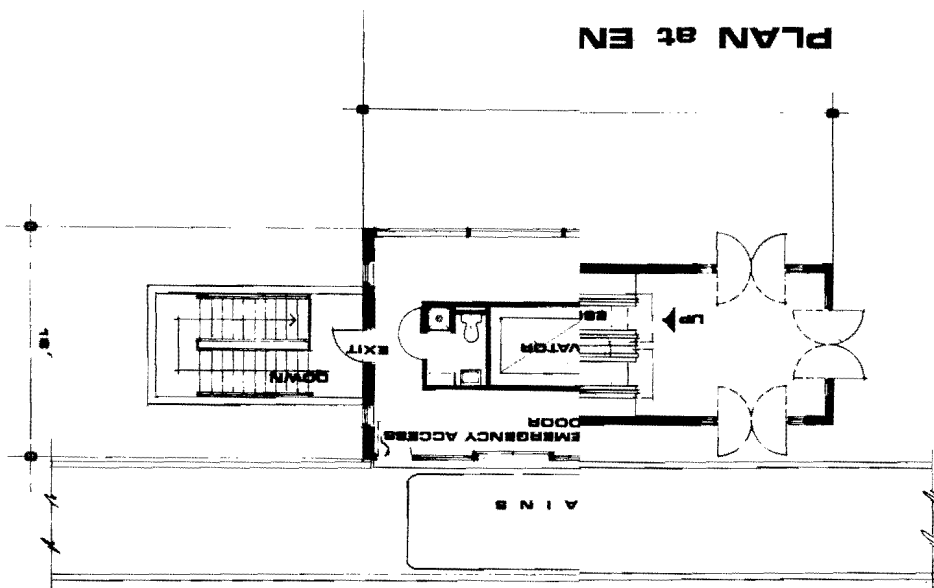
SCOTT-TI

Figure 51

PLAN at GF



PLAN at EN



HISTORIC

The preferred alignment is contiguous to 29 sites/buildings that have been determined by the Landmarks Association of St. Louis to have historic and/or architectural significance. Of this 29 only three, Union Station, the Old Post Office, and Laclede's Landing are listed on the National Register of Historic Places.

The interfacing of the guideway and stations with historic structures must be accomplished so that the DPM does not adversely affect the historical quality of the structures. Sensitive interfacing must be exercised on Tucker Boulevard at the Federal Courts/City Hall buildings and on 8th Street at the Old Post Office.

Preliminary environmental studies have concluded that if the DPM is constructed on the preferred alignment, it will not adversely effect the environmental quality of life in downtown St. Louis, Missouri.

IMPACTS ON BUS SYSTEM

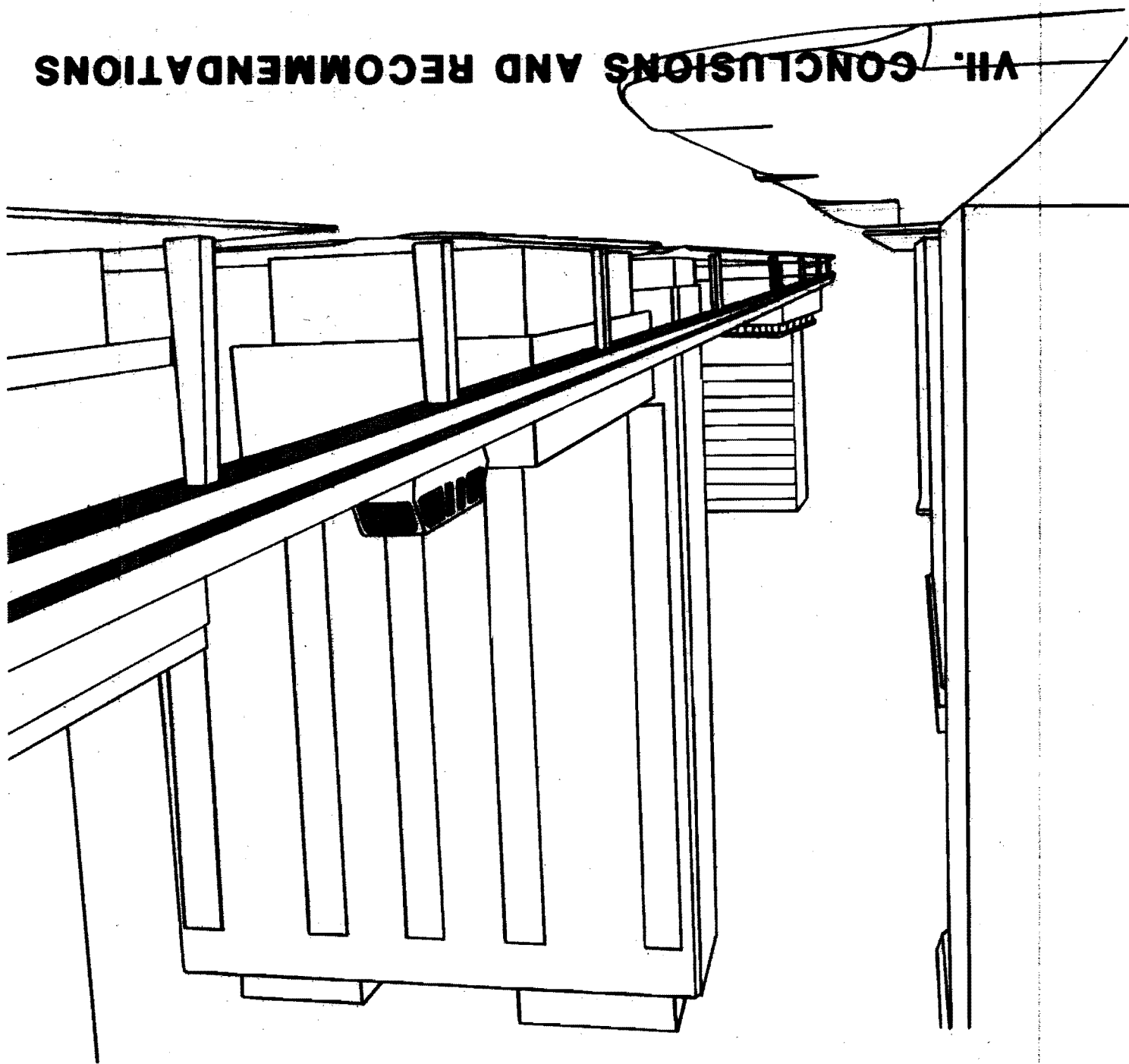
As further study of the selected alignment proceeded, an additional refinement to the bus-DPM interface scenario was developed. In the initial analysis of bus savings for the several alternatives described in Chapter 4, it was assumed that the local bus routes would be intercepted on the periphery of the proposed DPM Figure Eight loop of Alternative 4. Possible additional savings could be available to Bi-State by further truncating Bus Routes #20 - Cherokee and Bus Route #52 - Forest Park and re-routing these lines to interface with the DPM stations proposed along Clark Street, rather than bringing these routes to interface with stations along Tucker Boulevard. This refinement could result in an increase of total blocks saved per day from 21,604 to 13,492, and could increase the potential cost savings per day from \$2,135.00 to \$2,285.00.

A further investigation was made to assess the impact of Alternative 4 options on the local bus system. It was found that the optional stations for the Arch and Laclede's Landing would not alter the bus-DPM interface scenario. The optional station for Columbus Square could have a minor effect on local bus routing, but nothing which would significantly alter the bus savings figures given elsewhere in the report.

EXPANSION POTENTIAL

As shown in Figure 37, Alternative 4 has the potential to be expanded to the north, south, east and west. The extensions shown on Figure 4 are feasible extension, but they are not the only possible extensions. The figure-eight loop lends itself to shuttle extensions and additions of future loops. Alternative 4 has the capability of joining downtown St. Louis to East St. Louis.

VII. CONCLUSIONS AND RECOMMENDATIONS



VII. CONCLUSIONS AND RECOMMENDATIONS

This report has documented the Phase I activities of the St. Louis DPM Feasibility Study. Phase I has established goals and requirements, analyzed alternative configurations and routes, and assessed the economic and social feasibility of DPM technology in downtown St. Louis. The St. Louis DPM Feasibility Study began with the development of 14 alignments, was narrowed down to four alignments for alternatives analysis and finally one candidate alignment was selected for detailed study. This analysis and refinement of alternatives were executed to determine if a DPM is feasible for St. Louis.

The feasibility study investigated the satisfaction of goals, transportation needs, economic development, environmental impact and financial aspects of a DPM. The three goals ranked the highest by the TRC include: promote economic development, promote land use development in conjunction with transportation development, and improve the CBD transportation systems.

The recommended alignment will serve approximately 98 percent of the downtown employment, 98 percent of the CBD floor space, all of the CBD Class A hotel space and over 20,000 of the CBD parking spaces in structures. The DPM system will be responsible for the increase of approximately 100,000 square feet of office space a year. By 1990, the increase in annual CBD retail sales attributable to the DPM system will be approximately \$40 million (in constant 1980 dollars). This represents a gain of about 20 percent over the baseline (without DPM) projection and reflects expenditures by new office employees, businesses, convention delegates and visitors, plus increased expenditures by the existing CBD employees and visitors.

By 1990, the annual increase in city tax revenues attributable to the DPM will be in the range of \$1.6 to \$1.8 million dollars (in constant 1980 dollars). More detailed estimates of revenue will be included in the Phase II final plan. (Note: This incremental revenue is equivalent to the annual debt service cost to cover approximately \$15.5 million dollars of long-term capital borrowing at 9 percent over a 20-year pay back period.

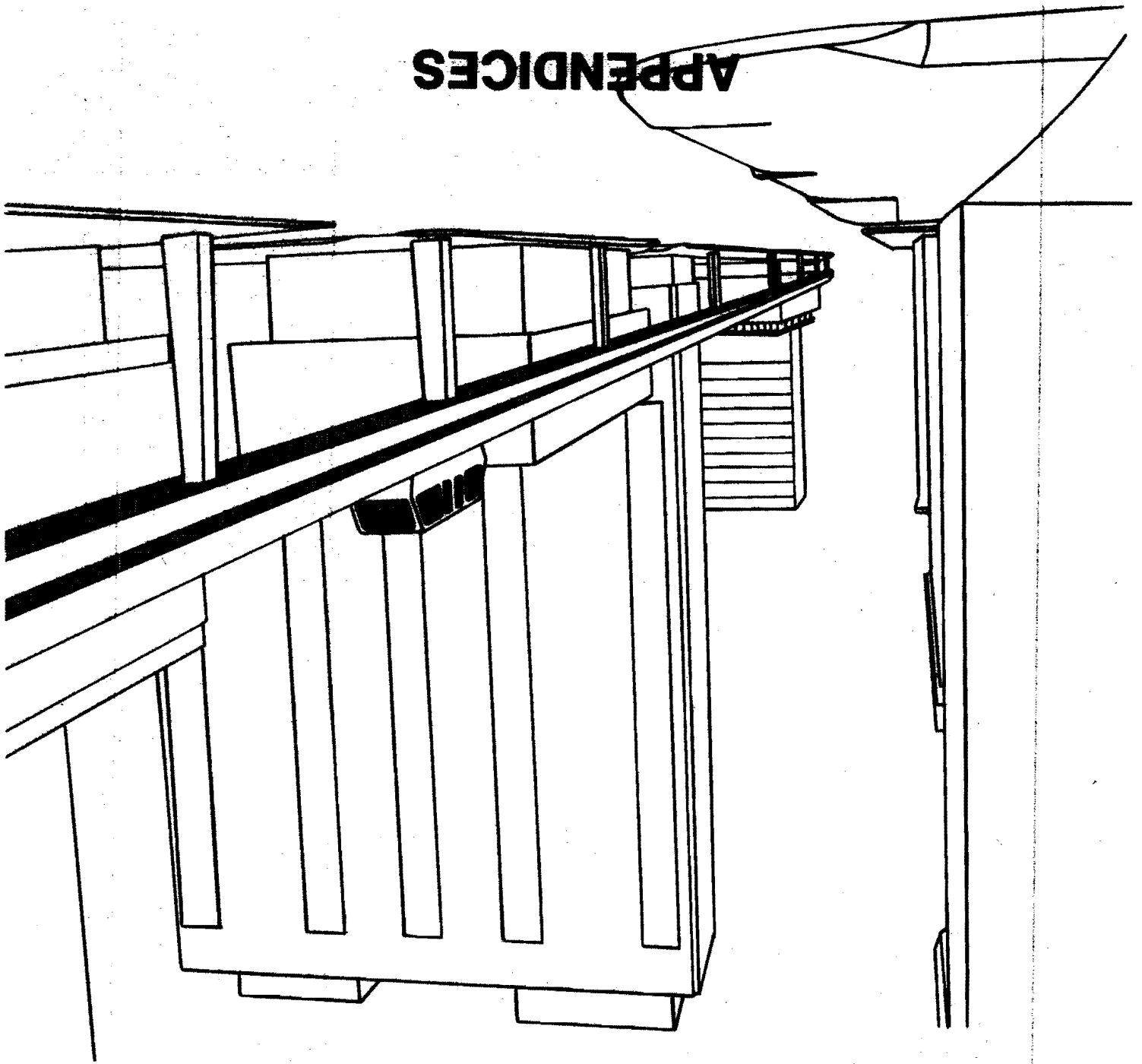
The DPM system in St. Louis will connect hotels, businesses, and the convention center, which will greatly increase St. Louis' ability to attract large conventions. This is especially beneficial to the economic development of St. Louis because expenditures by convention delegates and other visitors represent net economic gains to the region.

Alignment 4 and 4A will have an estimated 1985 daily patronage of 46,700 and 50,700 respectively. The potential 1985 passenger revenue is estimated at \$1,904,113 for Alignment 4 and \$2,200,473 for Alignment 4A. The annual bus cost savings will be approximately \$669,500 for Alignments 4 and 4A. Once the DPM system is in operation, the passenger revenues and bus cost savings will be equivalent to the O&M costs of the system, (\$2.3 - 2.8 million for Alignment 4 and \$2.4 - 3.0 million for Alignment 4A).

Alignment 4 will divert 25 percent of regional transit trips, 11 percent of regional auto, 5 percent of internal transit, and 4 percent of internal auto and walk trips. Those diversions will greatly improve traffic, noise, and air quality conditions within the CBD. In 1985, approximately 17,500 auto trips will be converted into DPM patronage.

Based upon the results of the Phase A activities which are documented in this report, the Project Team concurs that a DPM in St. Louis is feasible and recommends proceeding with Phase II-Preliminary Systems Plan for the DPM Feasibility Study. Phase II involves the detailed technical analysis of the recommended DPM alignment required to expedite preliminary engineering.

APPENDICES



APPENDIX A

ST. LOUIS DPM GOALS AND OBJECTIVES

	<u>SCORES</u>	<u>RANGE</u>	<u>MEAN</u>	TRUNC. <u>MEAN</u>	<u>MEDIAN</u>	<u>RANK</u>
Goal A	46	8-10	9.2	9.5	9	1
Goal B	45.7	8-10	9.1	9.2	9	2
Goal C	31.7	4-8	6.3	6.7	7	4
Goal D	38.7	7-9	7.7	7.6	7.7	3
Goal E	28	5-7	5.6	5.3	5	6
Goal F	30.5	5-7	6.1	6.2	6	5
Object. A1	424	72-100	84.8	84	81	1
A2	399	54-100	79.8	81.7	81	3
A3	300	27-80	60	64.3	64	6
Object. B1	410.7	72-90	82.1	82.9	81	2
B2	336	45-90	67.2	67	63	5
Object. C1	217.7	12-64	43.5	47.2	49	15
C2	261.7	32-72	52.3	52.6	56	11
C3	226	12-76	45.2	46	56	13
C4	168.3	4-56	33.7	36.1	41.3	19
Object. D1	344.7	56-81	68.9	69.2	70	4
D2	289	35-72	57.8	60.7	64	

APPENDIX A

ST. LOUIS DPM GOALS AND OBJECTIVES

	<u>SCORES</u>	<u>RANGE</u>	<u>MEAN</u>	<u>TRUNC.</u> <u>MEAN</u>	<u>MEDIAN</u>	<u>RANK</u>
Goal A	46	8-10	9.2	9.5	9	1
Goal B	45.7	8-10	9.1	9.2	9	2
Goal C	31.7	4-8	6.3	6.7	7	4
Goal D	38.7	7-9	7.7	7.6	7.7	3
Goal E	28	5-7	5.6	5.3	5	6
Goal F	30.5	5-7	6.1	6.2	6	5
Object. A1	424	72-100	84.8	84	81	1
A2	399	54-100	79.8	81.7	81	3
A3	300	27-80	60	64.3	64	6
Object. B1	410.7	72-90	82.1	82.9	81	2
B2	336	45-90	67.2	67	63	5
Object. C1	217.7	12-64	43.5	47.2	49	15
C2	261.7	32-72	52.3	52.6	56	11
C3	226	12-76	45.2	46	56	13
C4	168.3	4-56	33.7	36.1	41.3	19
Object. D1	344.7	56-81	68.9	69.2	70	4
D2	289	35-72	57.8	60.7	64	

APPENDIX B

Tables used in St. Louis DPM Analysis from UMTA Publication:

DPM: Planning for Downtown People Movers, DOT/Transportation Systems
Center for UMTA, April 1979, Volume I. (DOT-TSC-UM917-PP-79-8).

TABLE VI-6. SENSITIVITY OF REGIONAL CBD TRANSIT DIVERSIONS TO DPM
SPEED, SERVICE FREQUENCY AND FARE

● CBD Area = 1.0 sq. mi. - Spread Activity Distribution													
Number of Stations		4				8				12			
Station Spacing, Ft.		800	1200	1600	2000	800	1200	1600	2000	800	1200	1600	2000
Transit Delivery													
to Center	-Base	5	17	26	34	26	47	58	71	43	66	na	na
	20 mph	7	19	28	37	28	49	63	71	44	68	na	na
	1 min	8	19	28	37	28	49	63	71	44	68	na	na
	4 min	5	14	22	30	22	44	54	66	40	62	na	na
	10 ¢	2	8	16	22	15	34	45	54	33	57	na	na
	25 ¢	0	4	6	11	5	21	35	40	12	46	na	na
50% to Fringe													
	-Base	12	26	34	39	40	45	46	48	45	47	na	na
	20 mph	14	27	35	40	41	46	47	48	46	48	na	na
	1 min	13	27	35	40	41	46	47	48	46	48	na	na
	4 min	10	24	33	37	38	45	46	47	45	47	na	na
	10 ¢	6	19	31	35	37	43	45	46	44	46	na	na
	25 ¢	1	12	18	32	25	40	43	44	39	44	na	na
CBD Area = 1.0 sq.mi. - Concentrated Activity Distribution													
Number of Stations		4				8				12			
Station Spacing, Ft.		800	1200	1600	2000	800	1200	1600	2000	800	1200	1600	2000
Transit Delivery													
to Center	-Base	4	12	13	18	9	23	34	48	24	42	na	na
	20 mph	5	13	15	20	10	25	40	48	25	44	na	na
	1 min	6	13	15	20	10	25	40	48	26	44	na	na
	4 min	3	9	10	17	7	20	30	43	22	38	na	na
	10 ¢	1	4	6	9	3	13	22	31	14	32	na	na
	25 ¢	0	2	1	2	0	5	12	16	1	18	na	na
50% to Fringe													
	-Base	14	34	42	45	45	50	50	50	49	50	na	na
	20 mph	17	37	43	46	46	50	50	50	49	50	na	na
	1 min	17	37	43	46	46	50	50	50	49	50	na	na
	4 min	13	32	41	44	44	49	50	50	49	50	na	na
	10 ¢	6	24	39	42	41	48	49	50	47	49	na	na
	25 ¢	0	14	21	38	25	46	49	50	45	48	na	na

na - Not applicable

TABLE VI-5. PERCENT DIVERSION OF REGIONAL CBD TRANSIT USERS TO DPM AS FUNCTION OF CBD AREA, CBD CONCENTRATION, TRANSIT DELIVERY ARRANGEMENT, NUMBER OF STATIONS AND STATION SPACING

Number of Stations	4				8				12		
	800	1200	1600	2000	800	1200	1600	2000	800	1200	1600
Station Spacing, feet	2400	3600	4800	6000	5600	8400	11,200	14,000	8800	13,200	17,600
CBD Area = 0.5 sq. miles -- Spread Activity Distribution											
Transit Delivery											
To Center	7	23	36	52	37	56	na	na	58	na	na
25% to fringe	9	18	20	22	22	23	na	na	23	na	na
50% to fringe	19	36	40	45	43	46	na	na	47	na	na
100% to fringe	38	71	79	89	87	92	na	na	94	na	na
CBD Area = 0.5 sq. miles -- Concentrated Activity Distribution											
Transit Delivery											
To Center	2	8	17	29	15	28	na	na	34	na	na
25% to fringe	8	21	23	25	24	25	na	na	25	na	na
50% to fringe	16	42	46	50	49	50	na	na	50	na	na
100% to fringe	32	83	91	100	97	100	na	na	99	na	na
CBD Area = 1.0 sq. miles -- Spread Activity Distribution											
Transit Delivery											
To Center	5	17	26	34	26	49	58	71	43	66	na
25% to fringe	6	13	17	19	20	23	23	24	23	24	na
50% to fringe	12	26	34	39	40	45	46	48	45	47	na
100% to fringe	23	51	67	77	79	91	93	95	90	95	na
CBD Area = 1.0 sq. miles -- Concentrated Activity Distribution											
Transit Delivery											
To Center	4	12	13	18	9	23	24	48	24	42	na
25% to fringe	7	17	21	22	23	25	25	25	25	25	na
50% to fringe	14	34	42	45	45	50	50	50	49	50	na
100% to fringe	29	68	84	90	91	99	100	100	98	99	na
CBD Area = 1.5 sq. miles -- Spread Activity Distribution											
Transit Delivery											
To Center	1	7	13	39	17	37	56	60	38	59	68
25% to fringe	2	5	7	10	13	20	22	22	23	23	24
50% to fringe	4	9	13	21	26	40	44	44	46	47	47
100% to fringe	7	18	26	42	52	79	87	88	81	93	94
CBD Area = 1.5 sq. miles -- Concentrated Activity Distribution											
Transit Delivery											
To Center	2	7	11	24	11	21	25	31	20	36	45
25% to fringe	2	7	10	14	15	21	25	25	23	23	23
50% to fringe	5	14	21	28	31	43	50	50	46	46	46
100% to fringe	10	28	41	56	61	85	100	100	92	92	93

* Assumes a shuttle system where route length = station spacing times number of stations minus one

na - Not applicable

TABLE VI-9. PERCENT DIVERSION OF REGIONAL CBD AUTO USERS TO DPM AS FUNCTION OF AMOUNT AND DISTRIBUTION OF CBD ACTIVITIES, CBD SIZE, NUMBER OF STATIONS AND STATION SPACING (UNLIMITED FRINGE PARKING CAPACITY)

Number of stations Station spacing, feet Route length, feet *	4				8				12				
	800	1200	1600	2000	800	1200	1600	2000	800	1200	1600	2000	
	2400	3600	4800	6000	6800	8400	11,200	14,000	8800	11,200	17,600	22,000	
CBD Emplpy. (000's)	CBD Floor sp. (mil. sq. ft.)	CBD Area = 0.5 sq. miles, Spread Activity Distribution											
300	96	71	71	71	71	76	76	na	na	77	na	na	na
200	69	71	71	71	71	73	73	na	na	72	na	na	na
75	31.5	48	54	59	54	49	42	na	na	51	na	na	na
20	10	10	8	6	5	7	3	na	na	4	na	na	na
CBD Area = 0.5 sq. miles, Concentrated Activity Distribution													
300	96	75	75	75	75	76	77	na	na	78	na	na	
300	96	75	75	75	75	76	77	na	na	78	na	na	na
200	69	75	75	75	75	74	75	na	na	69	na	na	na
75	31.5	53	60	61	60	44	48	na	na	42	na	na	na
20	10	13	10	8	6	10	5	na	na	9	na	na	na
CBD Area = 1.0 sq. miles, Spread Activity Distribution													
300	96	33	45	56	65	75	74	75	74	76	74	na	na
200	69	33	45	54	58	69	70	69	66	70	69	na	na
75	31.5	22	28	32	31	38	45	34	30	40	38	na	na
20	10	3	4	4	4	3	2	0	0	2	1	na	na
CBD Area = 1.0 sq. miles, Concentrated Activity Distribution													
300	96	44	58	64	70	75	77	76	75	75	74	na	na
200	69	42	51	60	69	67	66	66	65	63	65	na	na
75	31.5	26	31	38	38	38	46	38	35	38	34	na	na
20	10	5	4	4	2	4	1	0	0	4	2	na	na
CBD Area = 1.5 sq. miles, Spread Activity Distribution													
300	96	18	22	28	33	40	62	74	74	70	74	74	70
200	69	18	22	28	31	38	57	64	62	61	65	62	61
75	31.5	12	15	17	19	20	29	27	22	27	25	20	14
20	10	2	3	2	2	3	2	0	0	2	1	0	0
CBD Area = 1.5 sq. miles, Concentrated Activity Distribution													
300	96	26	34	38	43	49	67	70	70	71	74	74	72
200	69	26	34	35	39	43	54	54	51	56	60	58	55
75	31.5	15	18	20	18	22	25	23	21	26	26	28	16
20	10	2	2	2	2	3	1	0	0	2	1	0	0

* Assumes a shuttle system where route length = station spacing times number of stations minus one
na = Not applicable

TABLE VI-10. SENSITIVITY OF REGIONAL CBD AUTO DIVERSION TO DPM SPEED, SERVICE, FREQUENCY,
AND FARE (UNLIMITED FRINGE PARKING CAPACITY)

CBD Arrangement	Spread				Concentrated			
CBD Employment (000's)	300	200	75	20	300	200	75	20
CBD Floorspace (mil.sq.ft.)	96	69	31.5	10	96	69	31.5	10
System								
Base	75	69	34	0	76	66	38	0
20 mph	75	74	46	3	77	68	47	4
1 minute headway	75	70	38	2	76	66	42	2
4 minute headway	75	68	27	0	76	66	30	0
10 ¢ fare	74	66	22	0	75	64	25	0
25 ¢ fare	71	54	6	0	74	53	7	0

TABLE VI-14. PERCENT DIVERSION OF INTERNAL CBD TRANSIT TRIPS AS A FUNCTION OF DPM AND LOCAL BUS OPERATING CHARACTERISTICS FOR CBD OF 200,000 JOBS

Number of Stations	4				8				12			
Station spacing, feet	800	1,200	1,600	2,000	800	1,200	1,600	2,000	800	1,200	1,600	2,000
Route length, feet*	2,400	3,600	4,800	6,000	5,600	8,400	11,200	14,000	8800	13,200	17,600	22,000
DPM Advantage												
None	0	0	0	0	0	0	0	0	0	0	n.a.	n.a.
Headway**	0	0	0	0	0	0	0	0	0	0	n.a.	n.a.
Speed***	0	0	0	0	0	0	0	0	0	0	n.a.	n.a.
Headway and Speed	0	0	0	2	0	0	0	2	2	2	n.a.	n.a.
Fare****	6	6	6	7	11	16	16	18	20	27	n.a.	n.a.
Fare and Speed	9	10	11	11	19	23	24	27	30	41	n.a.	n.a.
Fare and Headway	9	10	11	11	20	23	27	27	31	42	n.a.	n.a.
All three	11	15	18	18	24	34	39	28	41	58	n.a.	n.a.

* Assume a shuttle system where route length = station spacing times number of stations minus one.

** DPM headway equals 2 minutes and local bus headway equals 5 minutes.

*** DPM maximum cruise speed equals 20 mph.

**** DPM fare assumed to be 25 cents lower than local bus fare.

n.a. Not applicable

TABLE VI-16. PERCENT DIVERSION OF INTERNAL CBD AUTO TRIPS TO DPM AS FUNCTION OF AMOUNT AND DISTRIBUTION OF CBD ACTIVITIES, CBD SIZE, NUMBER OF STATIONS AND STATION SPACING

Number of stations		4				8				12			
Station spacing, feet		800	1,200	1,600	2,000	800	1,200	1,600	2,000	800	1,200	1,600	2,000
Route length, feet*		2,400	3,600	4,800	6,000	5,600	8,400	11,200	14,000	8,800	13,200	17,600	22,000
CBD Employ. (000's)	CBD Floorsp. (mil.sq.ft.)	CBD Area = 0.5 sq. miles, Spread Activity Distribution											
300	96	11	14	16	16	28	30	n.a.	n.a.	46	n.a.	n.a.	n.a.
200	69	10	12	12	13	23	25	n.a.	n.a.	36	n.a.	n.a.	n.a.
75	31.5	6	7	8	8	14	15	n.a.	n.a.	21	n.a.	n.a.	n.a.
20	10	2	2	1	1	3	2	n.a.	n.a.	4	n.a.	n.a.	n.a.
		CBD Area = 0.5 sq. miles, Concentrated Activity Distribution											
300	96	24	29	32	32	50	52	n.a.	n.a.	67	n.a.	n.a.	n.a.
200	69	22	23	23	28	42	46	n.a.	n.a.	57	n.a.	n.a.	n.a.
75	31.5	15	18	18	19	25	30	n.a.	n.a.	35	n.a.	n.a.	n.a.
20	10	4	4	3	3	9	0	n.a.	n.a.	12	n.a.	n.a.	n.a.
		CBD Area = 1.0 sq. miles, Spread Activity Distribution											
300	96	3	5	6	6	13	17	17	18	22	27	n.a.	n.a.
200	69	3	3	3	4	9	13	13	14	16	21	n.a.	n.a.
75	31.5	2	2	2	2	5	7	6	5	9	9	n.a.	n.a.
20	10	0	0	0	0	1	1	0	0	1	1	n.a.	n.a.
		CBD Area = 1.0 sq. miles, Concentrated Activity Distribution											
300	96	10	14	15	17	26	32	32	34	39	49	n.a.	n.a.
200	69	8	10	11	14	20	24	24	26	30	35	n.a.	n.a.
75	31.5	4	5	6	7	13	15	15	14	18	18	n.a.	n.a.
20	10	1	1	1	1	2	1	1	1	2	2	n.a.	n.a.
		CBD Area = 1.5 sq. miles, Spread Activity Distribution											
300	96	2	2	3	3	5	11	13	13	15	20	23	21
200	69	2	2	2	2	3	7	8	8	10	14	14	15
75	31.5	1	1	1	1	2	3	3	3	4	5	5	4
20	10	0	0	0	0	1	1	0	0	1	1	0	0
		CBD Area = 1.5 sq. miles, Concentrated Activity Distribution											
300	96	5	7	8	9	15	24	24	24	29	37	38	39
200	69	3	4	4	5	11	16	17	17	20	25	25	25
75	31.5	2	2	3	2	6	7	7	7	8	11	12	9
20	10	1	1	1	1	1	1	1	1	2	1	1	1

* Assumes a shuttle system where route length = station spacing times number of station spacing times number of stations minus one.
n.a. - Not applicable

APPENDIX C

BUS ONLY ALTERNATIVE METHODOLOGY

- Total Travel Time for Bus 37 min. 25 sec.
Dwell Time @ 17 Stations @ 20/Sta. 5 min. 40 sec.
43 min. 5 sec.

Average running speed for Bus 8.2 MPH

Distance round trip 26,950 feet

- No. of vehicles DPM @ 80 persons/vehicle - 2 minute headway peak hour

1 Bus = .5 DPM vehicle (80 persons)

1.5-2 buses required to meet same headway as DPM vehicle

DPM - 15 MPH; Bus - 8.2 MPH

Total number of buses required for system

DPM vehicles for 2 minutes headway - 19

Buses $19 / .5 \times 1.5 = 57$

with spares say 60 buses

- Cost of Bus Only Alternative

$60 \times 130,000 = \$ 7,000,000$ 10 year life

$60 \times (130,000 \times 2.16) = \underline{\$16,848,000}$

(8% escal) \$24,648,000 for 20 year life

- Capitol Costs for:

- Street Improvement

8th and Convention Place	500,000
Memorial and Convention Place	500,000
Markings/Signing Bus Lanes	500,000
Computerized Signal System	600,000
@ 40 locations \$15K ea.	
Master Controller	1,000,000

- Stations

17 protected areas and structures	<u>850,000</u>
-----------------------------------	----------------

- O&M Structure

Indoor-Storage	8,950,000
Say	9,000,000

- BUS ONLY COSTS

- O&M Cost = weekday

60 buses operate 4 hours/day

30 buses operation 12 hours/day

$$60 \times 4 \text{ hours} \times \frac{26,950 \text{ feet}}{5,280 \text{ ft/min.}} \div \frac{43 \text{ minute}}{60 \text{ min/hr.}} = 1,709 \text{ min.}$$

$$30 \times 12 \text{ hours} \times \frac{26,950 \text{ feet}}{5,280 \text{ ft/min.}} \div \frac{43 \text{ minute}}{60 \text{ min/hr.}} = 2,564 \text{ min.}$$

$$4,273 \times .2834/\text{min.} \times 5 \times 52 = \$ 314,850$$

$$(60 \times 4 \times 30 \times 12) \times 5 \times 52 \$15.025 = 2,343,900$$

- Saturday 50% weekday

30 bus + 16 hrs/day

$$15 \times 16 \times \frac{26,950}{5,280} + \frac{43}{60} = 1,709$$

$$3,419 \times .2834 \times 52 = \$50,385$$

$$1,709 \times .2834 \times 52 = \$25,185$$

Summary of Bus Only Alternative

- Capitol Costs

Construction \$ 9,000,000

Equipment 24,650,000

Say \$33.6 million

APPENDIX D

ABANDONED T.R.R.A. TUNNEL

A visual inspection of the abandoned railroad tunnel under downtown St. Louis was conducted by the Project Team on January 8 and 9, 1980. The purpose of this inspection was to make a preliminary evaluation of the tunnel from a structural viewpoint for possible use as part of the DPM system. Mr. Jack Falconer of the Terminal Railroad Association of St. Louis accompanied the inspection team as a guide because of his familiarity with the tunnel.

Description of the Existing Tunnel

The masonry tunnel constructed approximately 100 years ago carried two lines of railroad tracks under downtown St. Louis to the lower level of the Eads Bridge. The tunnel entrance is located at the intersection of Eighth Street and Spruce Street. The tunnel continues in a northerly direction under Eighth Street to Washington Avenue where it changes direction to proceed east to Eads Bridge. The tunnel has a total length of about 4400 feet from Spruce Street until it transitions into the approach structure at the west end of Eads Bridge.

The tunnel is a double arch structure consisting of vertical limestone walls at each side and down the center between the two sets of track. The arch portion is constructed of brick. Each arch spans about 18 feet horizontally over the tracks from the vertical limestone walls.

The outside walls of the tunnel vary from four to six feet in width. The center wall is three feet wide except where it approaches the Post Office Building between Locust and Olive, there it gradually widens from three feet to about ten feet. These areas are located between Stations 77+00 to 77+75 and Stations 81+30 to 82+00. Between Stations 77+75 and 81+30 the wall is also three feet wide with 5x5 feet brick piers, 36 feet on centers.

There are large arched openings in the center wall every 25 feet to permit easy access from one side to the other. The top of the tunnel arches are about five to seven feet below the existing street grades.

Typical sections of the tunnel at various locations in the tangent and curved portions are shown on the following pages. The dimensions shown on these sections have been verified to be correct within 0.1 foot. However, at the Post Office area indicated above, the tunnel is 19.8 feet wide on each side, and the roof of the tunnel consists of brick arches spanning parallel to the tracks, supported on double steel angles at about eight feet on centers.

Findings and Recommendations

The railroad tracks in west-south bound tunnel have been completely removed. In the north-east bound tunnel the tracks are still in place. If the tunnels are to be used for a DPM system, the existing tracks will have to be removed by T.R.R.A. of St. Louis who owns the tracks and the tunnel.

The only fallen brick from the arch was noted at about Station 61+27 in the west-south bound tunnel in an isolated area about 5x10 feet in size. One course of brick has fallen which would have to be replaced.

The outside wall of the west-south bound tunnel would require tuckpointing between approximately Station 60+27 to 65+27. The joints in the stone are open.

The center wall between Station 63+50 and 65+25 shows signs of weathering on both sides. Since this condition was not noted in any other location, it appears that a low quality limestone may have been used at this particular location. This stone would have to be replaced with new stone or concrete where extremely deteriorated.

Seepage in the tunnel was noted to be occurring at the following locations:

1. Station 74+00 through the tunnel arch in the west-southbound tunnel. This could be due to a broken water main in the vicinity as reported by the railroad representative.
2. From approximately Station 87+50 to 88+50 along the outside wall of the north-eastbound tunnel.
3. Approximately under Broadway, also along the outside wall of the north-eastbound tunnel. The seepage at this location is very bad, the water is actually entering from 2 places about 50 feet apart. Tuckpointing in this area is severely deteriorated.

The railroad representative indicated that the seepage along these areas is primarily due to broken sanitary sewers lines in the vicinity and not a result of ground water problems or storm water runoff. Sources of leakage would have to be identified and repaired followed by repair of damage tuckpointing.

In the last 100 feet of the north-eastbound tunnel, the arch has been repaired with Gunnite and this appears to have been an effective repair method. At approximately the midpoint of the tunnel (Station 85+00) the old ventilation shaft has been closed and the opening is bridged over by concrete T-beam floors of the new Mercantile Tower Building.

The tunnel has a drainage system included within its confines. It is currently not functioning properly due to lack of recent maintenance. The sand used to provide traction to locomotive wheels has clogged some of the lines, resulting in water standing in the tunnel, which was noted in the curved portion about two to three inches deep, and at the Post Office area about four to five inches deep. as noted previously, the site visit was made in January when ground water is normally low. It is known that there is in excess of one foot of water in the tunnel at times. The drainage system should be cleaned and any repairs performed to make it workable, or another

effective system should be installed in conjunction with the concrete floor slab which would be constructed as a base for a DPM system.

Debris and rubble (mostly broken concrete) was noted at the ventilation stack area in the north-eastbound tunnel. This debris may have accumulated during construction of the Mercantile Tower above this area.

Between approximately Station 65+50 to 67+50, the arch of the tunnel is presently shored up due to construction at Walnut Street. This appears to have been a precaution taken by the contractor involved to insure no damage in the tunnel during construction. However, this would bear further investigation if it were decided to use the tunnel as part of the route of the DPM system.

The west approach to the Eads Bridge is suffering from deterioration. The concrete approach section exhibits cracking and spalling of concrete and rusting reinforcing steel is exposed. This area would require further evaluation for major rehabilitation if its use as a station along a DPM route and/or a turning point is considered.

Conclusions

The visual inspection revealed the tunnel to be structurally in good condition. The areas of deterioration noted are not major and can be repaired without difficulty. The criteria for use of the tunnel will depend on the dimensions of the system to be proposed and whether there is adequate clearance in the tunnel for accommodation of such system, in addition to environmental and operational considerations.

If such criteria can be met and the tunnel can be utilized for a DPM facility, it appears feasible that stations can be accommodated at the two approaches to the tunnel (at Eighth Street and Eads Bridge) and at the Post Office Building area.

There is currently a study being conducted as to the feasibility of use of the tunnel for a Light Rail system. The tunnel may accommodate one system or the other, if all criteria are met, but under no circumstances can the tunnel accommodate both systems.

APPENDIX E

TYPICAL DPM STATION

Following is a description of a typical free standing single lane DPM station. The station is accessible to the handicapped and climate controlled. Typical schematic floor plans and elevations are detailed in this section.

DESIGN ASSUMPTIONS

The following assumptions were made in order to develop criteria for the schematic design:

- A two car people mover train of large configuration will be used, requiring four sets of bi-parting doors at the platform level.
- The floor elevation of the transit vehicle (and therefor of the platform) will be 21 feet above the street level.
- Stations will be completely unattended except for cleanup and maintenance functions. Therefore:
 - Positive control of fare collection and access to the platform area must be maintained.
 - Design should provide an open feeling, to discourage vandalism, provide for actual safety of patrons and a "feeling" of safety which will encourage use of the system. Places where potential muggers might lurk must be minimized. Lighting must be sufficient.
 - Architectural finishes and basic structure should be as vandal-proof as possible and provide for low maintenance costs.

- An hydraulic elevator will be necessary to accommodate the handicapped.
- An escalator will be necessary to transport passengers from ground level to platform level.
- An escalator would be desirable for pedestrian movement from platform level to ground level, however, a stair would be satisfactory.
- It should be possible to securely close down a station, either during low patronage times or for repair work.

The Building Division of the City of St. Louis indicated that two means of exit from the platform area will be required and that the two means must be as remote from one another as possible. They also indicated that an escalator would qualify as a means of exit.

DESIGN SOLUTION

The design is based on the conception of the concourse as a bridge, spanning between the vertical pedestrian movement elements. This allows construction at the ground level to be minimized, limiting interference with normal pedestrian flow, maintaining an "open feeling" at the sidewalk level and limiting places where muggers might hide.

Fare collection is provided by coin operated full height, full barrier turnstiles. (Normal low push-through turnstiles are only workable under supervised conditions.) The exit turnstiles provide one-way operation, preventing entry. A full height metal fence separates the entry and exit turnstile areas. An emergency exit gate in the fence is provided.

There is no known system for controlling access by the handicapped and preventing abuse of the fare system. Wheelchairs require access via a door or gate, as they cannot pass through a turnstile. Therefore, the elevator is the weak link in the fare collection system. While coin operation is possible, it is also possible that more than one person may enter the elevator at the same time. Additional research into this problem will be necessary.

The ground level entry area will be heated by electric radiant panels mounted at the ceiling. Cooling of this area will occur by cooled air ducted underground from the mechanical room and dropping by gravity down the escalator enclosure. The Concourse level will be heated and cooled by forced air ducted in the hollow "bridge" structure.

Emergency ventilating windows are provided.

The Utility Closet adjacent to the elevator is provided as a base for maintenance and cleaning functions. Also provided are a toilet and lavatory for the use of maintenance personnel. The emergency gate at the control area can be used to get cleaning and maintenance equipment through the control barrier.

The station can be securely closed down by locking the doors at the entry level.

In addition to the criteria listed previously, there are several design options inherent within the concept presented. They are as follows:

- An additional set of platform doors can be added opposite those shown, in order to serve a double loaded condition.
- As the long span structure of the concourse provides sufficient clearance, the station can be located at an intersection with the intersecting street passing underneath.

- An additional set of fare collection and exit turnstiles, and additional escalators (or escalator and stair) can be located at the opposite end of the concourse (in lieu of the emergency stair) to provide additional capacity and entry at both ends.

PRELIMINARY COST ESTIMATES

Costs are listed in 1980 Dollars. Information sources are shown in parentheses. Where source is not indicated, costs were developed by STA.

CSI
Div.

Sitework

Unknown

Concrete (includes formwork and reinforcing)

Footings, foundations	Lump sum	\$ 12,000
Architectural concrete	Lump sum	186,000
Finishing of slabs	Lump sum	1,500
Sandblasting	Lump sum	14,500

Metals

Miscellaneous Metals:

Handrails	78 l.f. @ \$ 15/l.f. = 1,170	
Grille	28 l.f. @ \$ 50/l.f. = 1,400	
Gate	<u>450</u>	3,020

Carpentry (included in concrete and G.C. supervision costs)

Thermal and Moisture Protection

Membrane roofing:

Entry building	380 s.f. @ \$ 3/s.f. = 1,140	
Canopy at platform	284 s.f. @ \$ 3/s.f. = <u>850</u>	1,900

Barrel vault enclosures:

Concourse & platform	2400 s.f. @ \$40/s.f. = 96,000	
Escalator	320 s.f. @ \$45/s.f. = <u>14,400</u>	<u>110,400</u>

Doors and Windows

Hollow metal doors and frames:

3 single @ \$750/ea. = 2,250	
1 double @ \$1,250 = <u>1,250</u>	3,500

Entrances & glazing:

Entrances and sidelights	3 @ 5,000 = 15,000	
Glazed wall at platform	325 s.f. @ \$26/s.f. = <u>8,450</u>	23,450

Bi-parting doors at platform (Dor-O-Matic):	34,000
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Finishes

Wood parquet flooring: 1956 s.f. @ \$ 5.50/s.f. =	10,760
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Gypsum wallboard systems:

Shaft	525 s.f. @ \$ 4.35/s.f. = 2,280	
General	320 s.f. @ \$ 2.00/s.f. = 640	
Canopy @ platform doors	Lump Sum 1,800	
Canopy @ turnstiles	Lump Sum <u>1,800</u>	6,520

Ceramic tile:

Floor	35 s.f. @ \$ 3.15/s.f. =	110	
Base	30 l.f. @ \$ 5.00/l.f. =	<u>150</u>	260

Specialties

Toilet accessories:	Lump sum	100
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Fare collection and control system:

Turnstiles (Perey Mfg. Co., NYC)	3 @ \$15,000 =	45,000
	2 @ \$13,200 =	<u>26,400</u>

Subtotal	71,400
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Bill changing machine (National Rejectors)	<u>3,000</u>
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Total	74,400
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Conveying Systems

Elevator (Westinghouse):	40,000
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Escalators (Westinghouse):	2 @ \$70,000	140,000
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Mechanical

Plumbing:	4,500
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HVAC systems:	47,000
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Electrical

Lighting and power systems:	46,000
Closed circuit TV monitoring system:* (Gonzalez, Inc.)	2,500
Emergency phone system:*	<u>600</u>

*Equipment cost only - does not include central monitors and control room requirements.

Subtotal	\$ 763,000
Contingency @ 10% =	<u>76,300</u>
Subtotal	839,300

General Conditions, Taxes, G.C. Supervision, OH & P @ 35% =	<u>293,755</u>
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TOTAL	\$1,133,055
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ALTERNATIVES

Alternate No. 1 - Down Escalator

Omit the down escalator and in lieu thereof provide a stair.

	Deduct	<u>96,200</u>
Cumulative Total		\$1,036,055

Alternate No. 2 - Parquet Flooring

Omit the wood parquet flooring and in lieu thereof provide hardened concrete.

	Deduct	<u>15,979</u>
Cumulative Total		\$1,020,876

COST ANALYSIS

The design presented in this report is similar to UMTA's Concept A, Report No. UMTA-IT-06-0152-79-6 dated July 1979 (Chapter 8, Baseline Station Concepts).

The projected station cost included in the UMTA report for Concept A is \$734,279 in 1978 dollars. Escalated at the past construction industry inflation rate of 18% annually, this cost would be \$1,022,410 in 1980 dollars.

The projected St. Louis station at \$1,133,055 compares favorably with the escalated cost for Concept A in the UMTA study.

